The Electrical Industry's Weekly Magazine

January 18, 1960

Electrical World

Price 50 Cents

A McGraw-Hill Publication

How Digital Computers Will Control Units at Huntington Beach ...p 50

Business Outlook: Housing May Be Only Hitch in '60.. p

UNIV MICROFILMS INC
EDITORIAL DEPT
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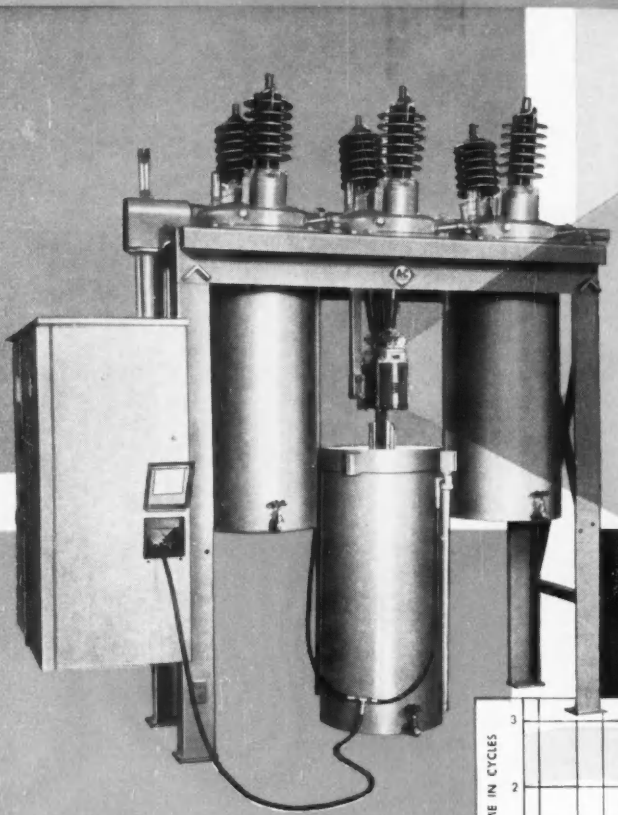
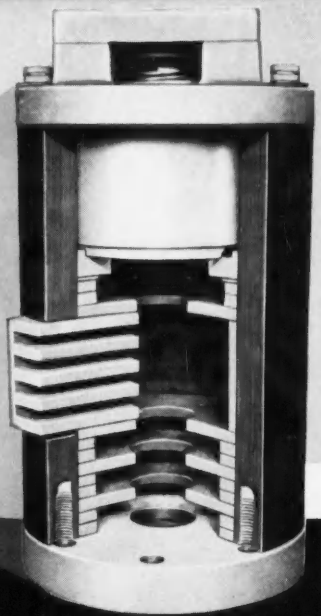
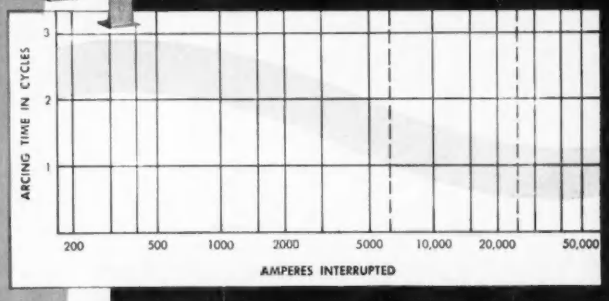
ALLIS-CHALMERS... Pacing Power Progress



Ratings: 23 kv to 46 kv, 500,000 through 1,500,000 kva.



Cross-blast principle of new LC interrupter cuts arcing time.



Graph shows short arcing times.

industry's newest interrupter

Here's new high-speed interrupting efficiency for Allis-Chalmers frame-mounted circuit breakers. New LC interrupter cuts arcing time. There's greater system protection, less oil contamination. Dielectric strength is extended, maintenance lowered.

More A-C breaker bonus benefits! You get mechanically trip-free operation. Highly successful *Pneu-Draulic* operator provides fast operation — ends moisture, rust, freezing. Hydraulic power-operated tank lifter cuts raising and lowering time by 80%.

For all the facts on these frame-mounted breakers, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

Pneu-Draulic is an Allis-Chalmers trademark.

A-1204-E

Electrical World

Vol. 153, No. 3 JANUARY 18, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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CURRENT EVENTS

1960 a Key Year for Electric Vehicles

Promising potential for truck and growing interest in small cars indicate that electric's renaissance is at hand.....p 44

Warm Weather Holds Down Winter Peaks

Residential loads below estimates, but resumption of steel production helps push up industrial loads.....p 42

GENERATION

Computers to Automate Huntington Beach

W. L. Chadwick, Southern California Edison Co

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TRANSMISSION

EHV Line to Carry Full 460 Kv

E. S. Kocsan, Pennsylvania Electric Co

Penelec 3-phase experimental line to start as part of grid; ultimate project may bring low-cost power east.....p 47

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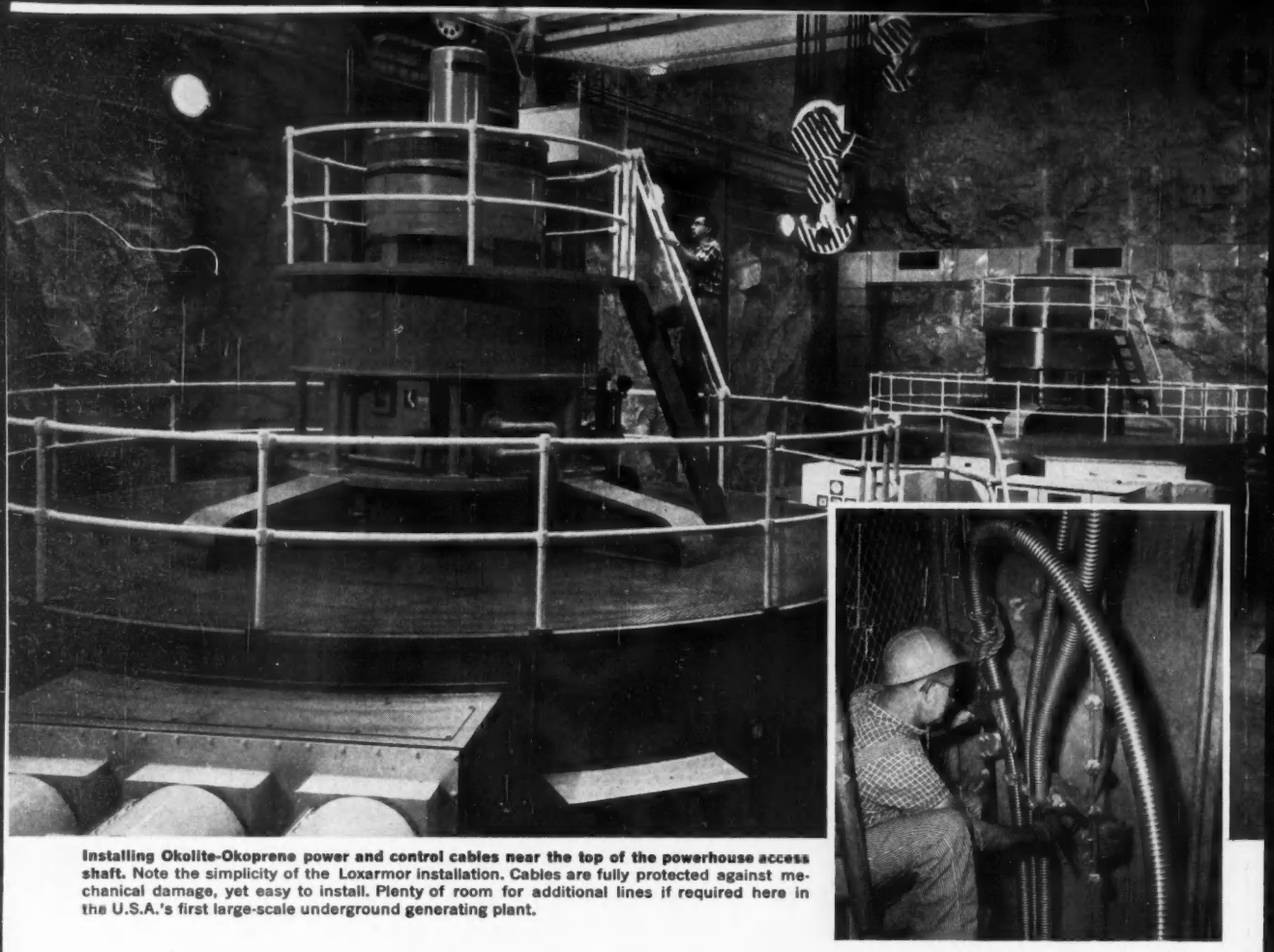

Installing Okolite-Okoprene power and control cables near the top of the powerhouse access shaft. Note the simplicity of the Loxarmor installation. Cables are fully protected against mechanical damage, yet easy to install. Plenty of room for additional lines if required here in the U.S.A.'s first large-scale underground generating plant.

Underground powerhouse uses Okolite-Okoprene Cables

Two-thousand feet inside a granite mountain in California, 500 feet below the surface, are the generators of the new Haas Powerhouse that contribute 128,000 kilowatts to Pacific Gas and Electric's big King's River development.

Leading straight up the 480-foot elevator shaft above the generator room, through the rock to the switchyard atop the mountain ridge, are 10 Okolite-Okoprene Loxarmor-protected cables which handle switchyard control and auxiliary power circuits. Interlocked armor construction provides permanent mechanical protection without the difficult installation problems of conduit and the higher cost of either conduit or "bore hole" suspension.

Installations where both economy and reliability are important prove the benefits—to you—of service-proved Okonite cables. There are four basic reasons for the successful service of Okonite cables in every type of installation.

1. **Engineering experience,** derived from developing longest-lived cables for every type of utility and industrial application.
2. **Quality materials,** maintained without compromise for every component and through every stage of manufacture.
3. **Manufacturing skill,** achieved by 80 years' work with all known insulating methods.
4. **Quality control,** accomplished by maintaining the strictest, most thorough testing methods in the industry.

When the best can also save you money—as these Okolite-Okoprene Loxarmor cables do in ease of installation and long-term economy—then it deserves serious study.

Send for Okonite Bulletin EW-1090 for full facts on Loxarmor. This economical and flexible covering may be the answer to your cable problem.

THE OKONITE COMPANY
Subsidiary of Kennecott Copper Corporation
Passaic, New Jersey

where there's electrical power . . . there's **OKONITE CABLE**

6521

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LETTERS

Editorial Sparks Interest in EHV Insulation

To the Editor:

This is with reference to *Electrical World's* Editorial Comment of August 10, 1959 on "Tailored Synthetics and the EHV Dielectric Dilemma." The comment was much to the point and very timely in calling the attention of many people in the electrical industry to the impending need for thoughtful review of steps to be taken in order to assure availability of adequate electrical cable insulation when higher voltage levels become necessary for EHV power transmission.

Developments in conventional oil-impregnated paper insulation have progressed in the past few years to the extent that cable manufacturers are submitting cable with this type of insulation for the 345-400 kv field tests at Cornell University. In addition, one cable will be provided with synthetic insulation, and it will be very important to learn how the two types of insulation will perform in this field test. Much work is also being done in Europe toward application of synthetic insulation to EHV power cables.

It is important to note, however, that considerable thought prevails that new materials will be needed definitely when a still higher voltage level becomes necessary. While much time may pass before levels past 400 kv will be in demand, it will also take considerable time to develop new materials if they are found to be necessary. Therefore, the present time does not appear to be too early for starting a review of the steps needed for procurement of such materials.

In the past six years, the Insulations Subcommittee of the AIEE Insulated Conductors Committee has given much attention to the possible future need of synthetic insulating materials for EHV underground cable.

The Detroit Edison Company has been active in studies in the underground cable field for many years, and is always alert to future requirements for developments related to system growth. In this connection, the Engineering Research Department of the Detroit Edison invited Mr. Wyatt to present a talk at the Laboratory covering his ideas regarding "Proposals for the Development of Insulation Specifically for Extra High Voltage Cables Through Molecular Design". . . .

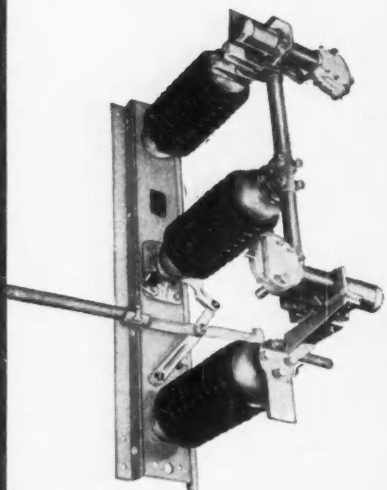
I understand that in Europe studies are now being made on new tailor-made molecules for new insulation materials for heavy electrical machines, but not for EHV underground cable.

Joseph Sticher
Division Supervisor
Detroit Edison Co

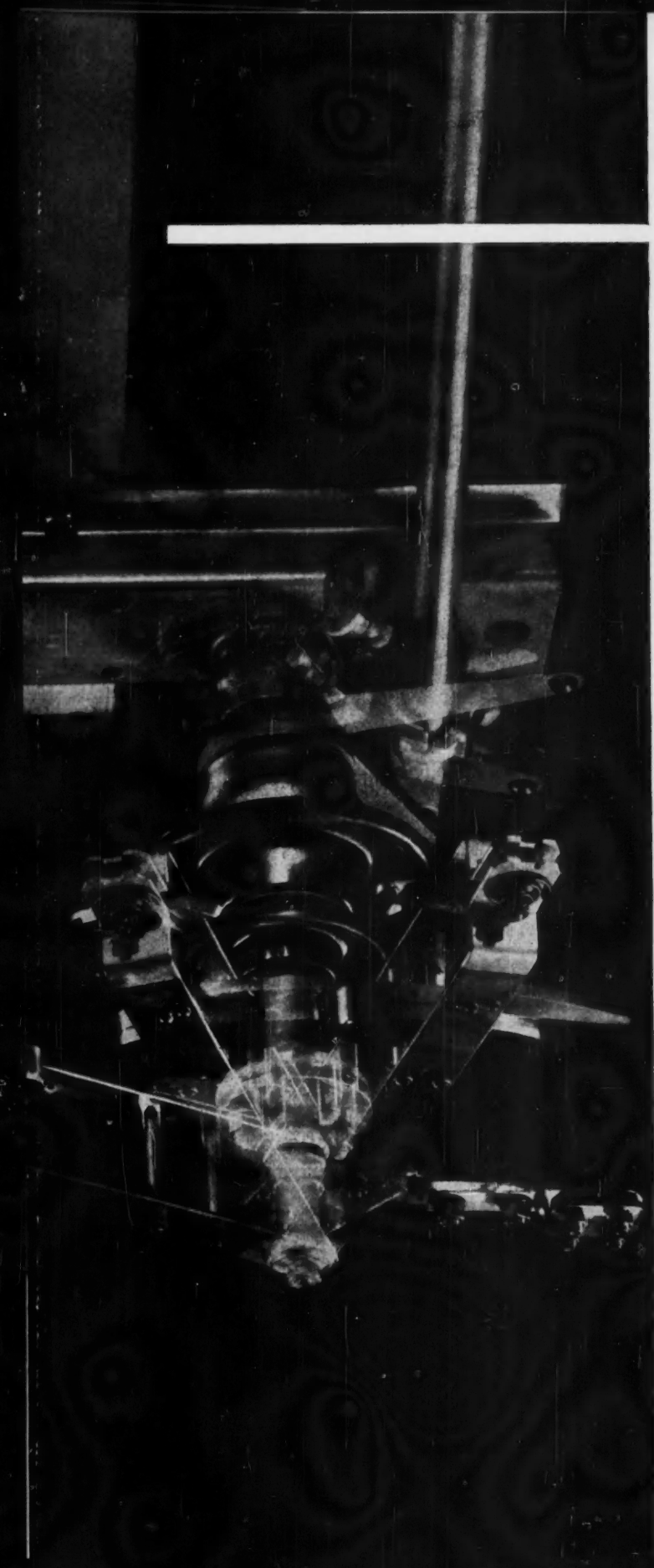
▶ We are pleased to publish in our Jan. 25 issue the Wyatt talk referred to by Reader Sticher.

SPLIT THE LOAD

(OR EVEN DUMP IT)



Double-Break Style, 34.5 kv rating (above) and Side-Break Style, 14.4 kv rating (right)



with S&C Load Interrupters that cost no more than disconnects

Now from S&C you can get load interrupters at the same price as disconnects. This means that you can handle any kind of line switching in the simplest way at the lowest possible cost.

Here are the devices that do it:

1. The Side-Break Alduti Load Interrupter at 7.2 kv and 14.4 kv, and
2. The Double-Break Alduti Load Interrupter at 23 kv and 34.5 kv.

Both give you load dumping* (full 600-ampere arc-free load switching at full line voltage) along with loop sectionalizing (switching currents in parallel or loop circuits) and line dropping (switching line charging currents).

Since these switching duties at today's voltages and loads can't be handled by disconnects, why not compare the cost of S&C Load Interrupters with disconnects. You'll find there's no premium price for premium performance.

Here are some of the other advantages of S&C Load Interrupters:

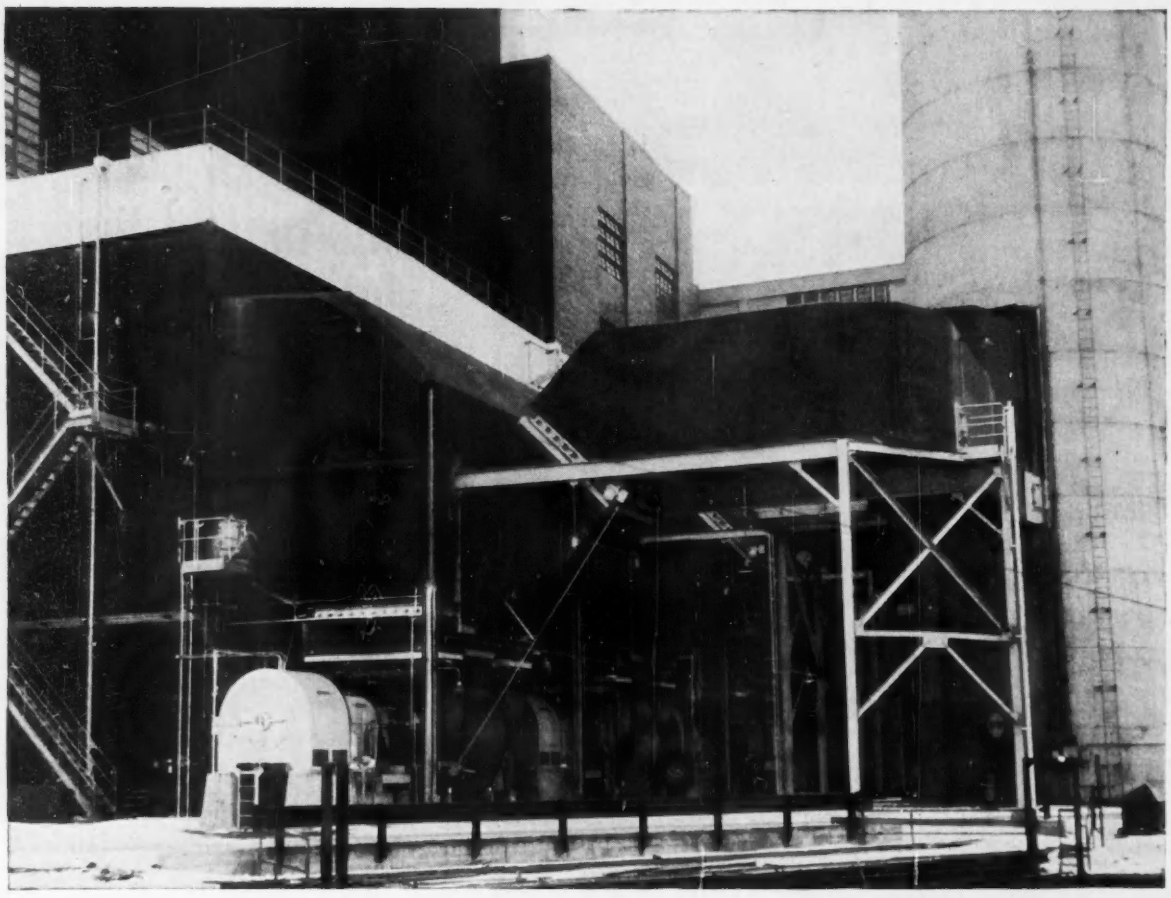
- 600-amp load switching without line or feeder breaker openings
- a maintenance-free interrupting device
- no external arc
- can be mounted in any position . . . vertical, upright or inverted.

For more information, please contact S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Ill.

* Important because: (1) Emergency situations (wires down, etc.) demand quick action, hence dumping the load. There is no time to set up communications for complicated breaker and switch sequencing. And (2) there's always the possibility of an operator error or misunderstanding, with the result that a loaded circuit may be dumped inadvertently.

S&C ELECTRIC COMPANY

S&C



"Buffalo" Induced Draft Fans at Commonwealth Edison Company's Waukegan Station, Unit 7. Fans draw from a common precipitator plenum chamber and discharge into a common stack. Fans deliver 312,000 cfm at 21" S.P. at 300° F., have air cooled bearings. Engineered by Sargent and Lundy.

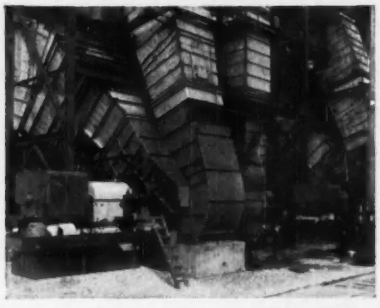
COMMONWEALTH EDISON COMPANY SELECTS "BUFFALO" FOR INDUCED DRAFT

The Commonwealth Edison Company has, over the years, purchased numerous "Buffalo" fans. This is a tribute to the performance, quality and long service life of "Buffalo" Products.

This same reliable performance and "Q" Factor Quality Construction is available to you in every "Buffalo" fan.

You are assured of getting the right fan for every job, too, since "Buffalo" offers a complete line of fan wheel types, each suited to a different set of circumstances.

The next time you need fans for any installation, large or small, be sure to phone your "Buffalo" Engineering Representative. He will have the best fan for the job and the experience necessary to see that it is recommended.



Installation photo, Commonwealth Edison Company's Will County Station Unit 3. This is one of four I. D. Fans now operating at 237,500 cfm at 15" S. P., 300° F. Engineered by Stone and Webster Engineering Corp.

Construction photo showing three of the four "Buffalo" I. D. fans at Commonwealth Edison Company's Fisk Street Station. These fans are now each operating at 362,300 cfm at 23.2" S.P., 325° F. Engineered by Bechtel Corp.

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VICTOR No. 900 10" Suspension Insulators are the universal choice of power men . . . helping maintain continuity of service under the most rugged conditions.

Records of utility companies are best evidence of the performance of VICTOR Suspension insulators. This is the reason why VICTOR is being chosen by more and more power companies for whom the best is none too good.

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I-T-E CIRCUIT BREAKER COMPANY

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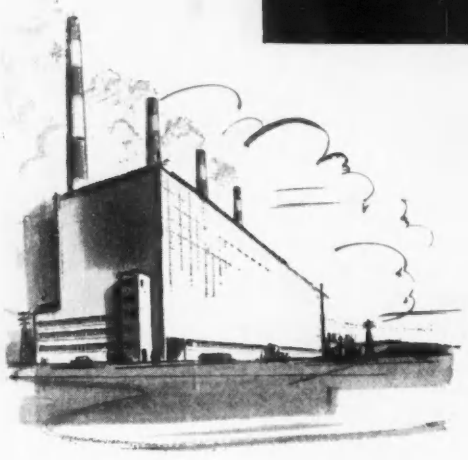


HIGH CAPACITY GENERATING STATION TRANSFORMERS

TRANSMISSION SUBSTATION TRANSFORMERS

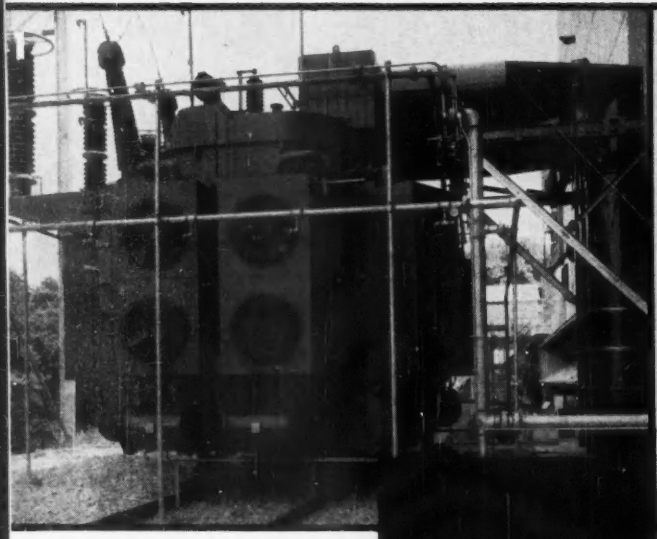
LTC TRANSFORMERS

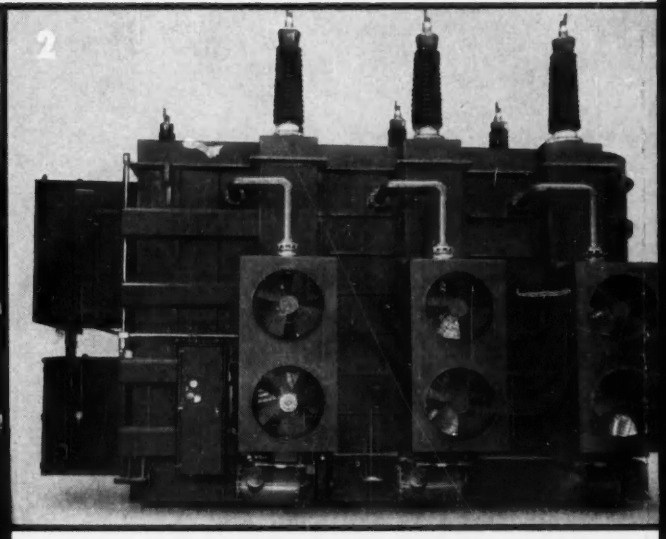
AUTOTRANSFORMERS

TRANSFORMERS OF SPECIAL ELECTRICAL OR MECHANICAL DESIGN

Versatility in transformer design and manufacture is one of the attributes which contribute to Moloney's leadership in the transformer field. Shown here are some of the many instances where Moloney has designed transformers to meet the exact requirements dictated by the peculiarities of the specific installation.

These installations exemplify the flexibility, versatility and capacity which enable Moloney to manufacture quality transformers for every application. Whatever your power transformer requirements . . . Specify Moloney Transformers . . . All Along The Line.





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FACTORIES AT ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

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Potomac Electric Power Company

2 *160,000 KVA, Class FOA, 161—115 KV & 13.8 KV @ 42,000 KVA, LTC Autotransformer*
Kansas City Power & Light Company

3 *135,000 KVA, Class FOA, 13.8—115 KV*
New Orleans Public Service, Inc.

4 *125,000 KVA, Class FOA, 13.8—138 KV, LTC*
Union Electric Company

5 *100,000 KVA, Class FOA, 14.4—161 KV, LTC*
Iowa Power and Light Company

6 *20,000/26,667 KVA, Class OA/FA, 132—12.6 KV, LTC*
Commonwealth Edison Company

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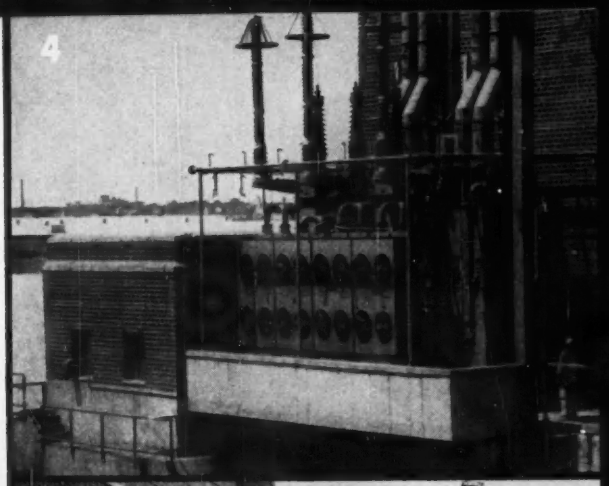

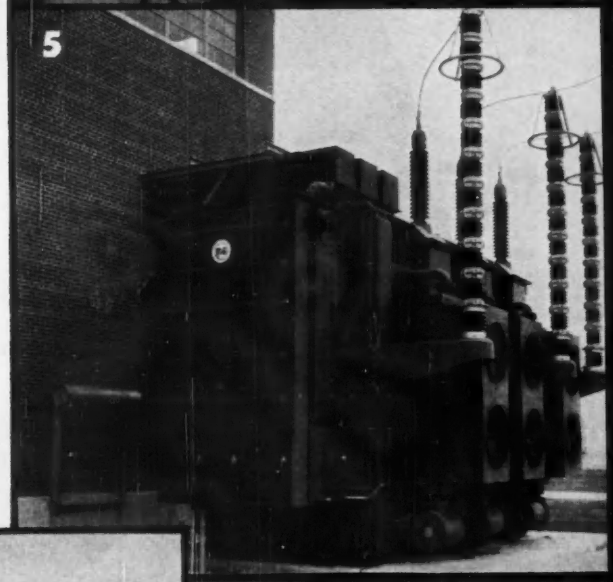

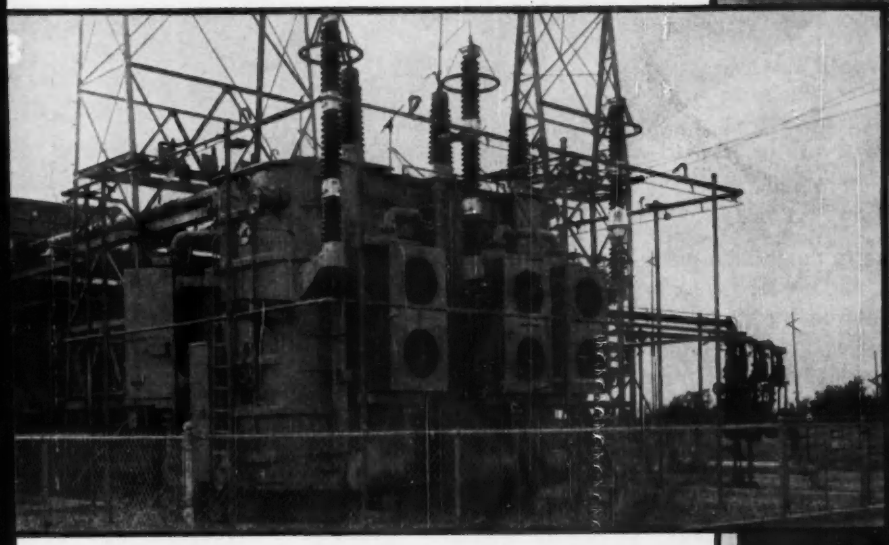

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When piping costs come close to the million mark — when the installation is vast, and the leeway for error is small — a piping job must be right from the start to finish. Grinnell assures this through complete one-company control and responsibility. From interpretive engineering — through exclusive methods of prefabrication and testing of pipe and hanger units — to precision assembly and delivery, the job is all done by Grinnell, as only Grinnell can do it. The result: installations of any size, at costs known before you start, with assured performance. Grinnell Company, Inc., Providence, R. I.

Current Grinnell piping responsibilities. Ohio Power Company, West Virginia; National Aniline Division of Allied Chemical & Dye Corporation, Virginia; Memphis Light, Gas and Water Division, Tennessee; Aluminum Company of America, Indiana; South Carolina Electric & Gas Company, South Carolina; City Public Service Board, San Antonio, Texas; Duke Power Company, North Carolina; Union Bag-Camp Paper Corp., Virginia; Pennsylvania Power & Light Company, Pennsylvania; Holyoke Water Power Company, Massachusetts.

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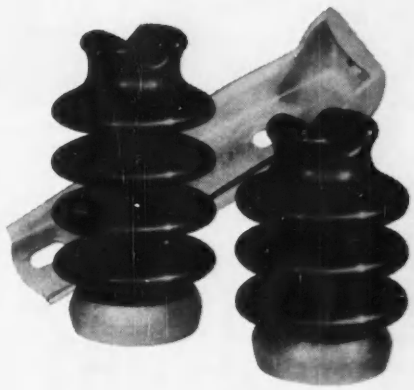


LAPP DISTRIBUTION POSTS

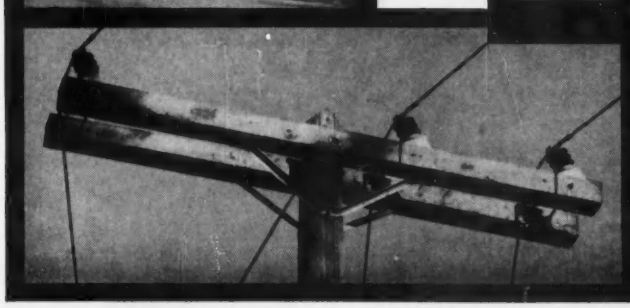
Line Post reliability for distribution lines up to 27 kv

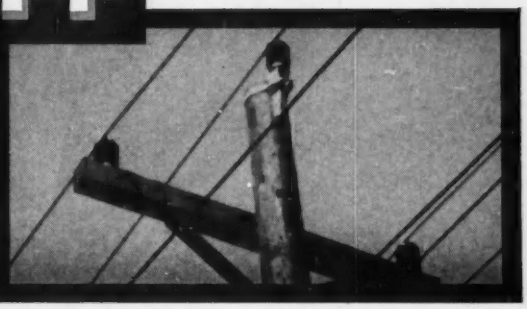
No distribution line you can build will serve as dependably, save as much sleep for your maintenance crews, or build as much customer good-will, as the one you put on Lapp Distribution Posts. These trim-appearing "junior Line Posts" just won't puncture . . . their solid one-piece porcelain body separates conductor from ground for its full length. Won't crack either . . . the only metal-to-porcelain joint is at the base; loading of porcelain is only in large-area, low-intensity compression. Greatly more resistance to flashover and impact, too . . . has short super-sturdy petticoats, with extra protection against failure in the fact that when petticoats are broken away, the post body remains intact with almost its full insulating values. Completely free of radio- or TV-interference at any operating voltage. Fog-type for superior performance in dust or atmospheric contamination.

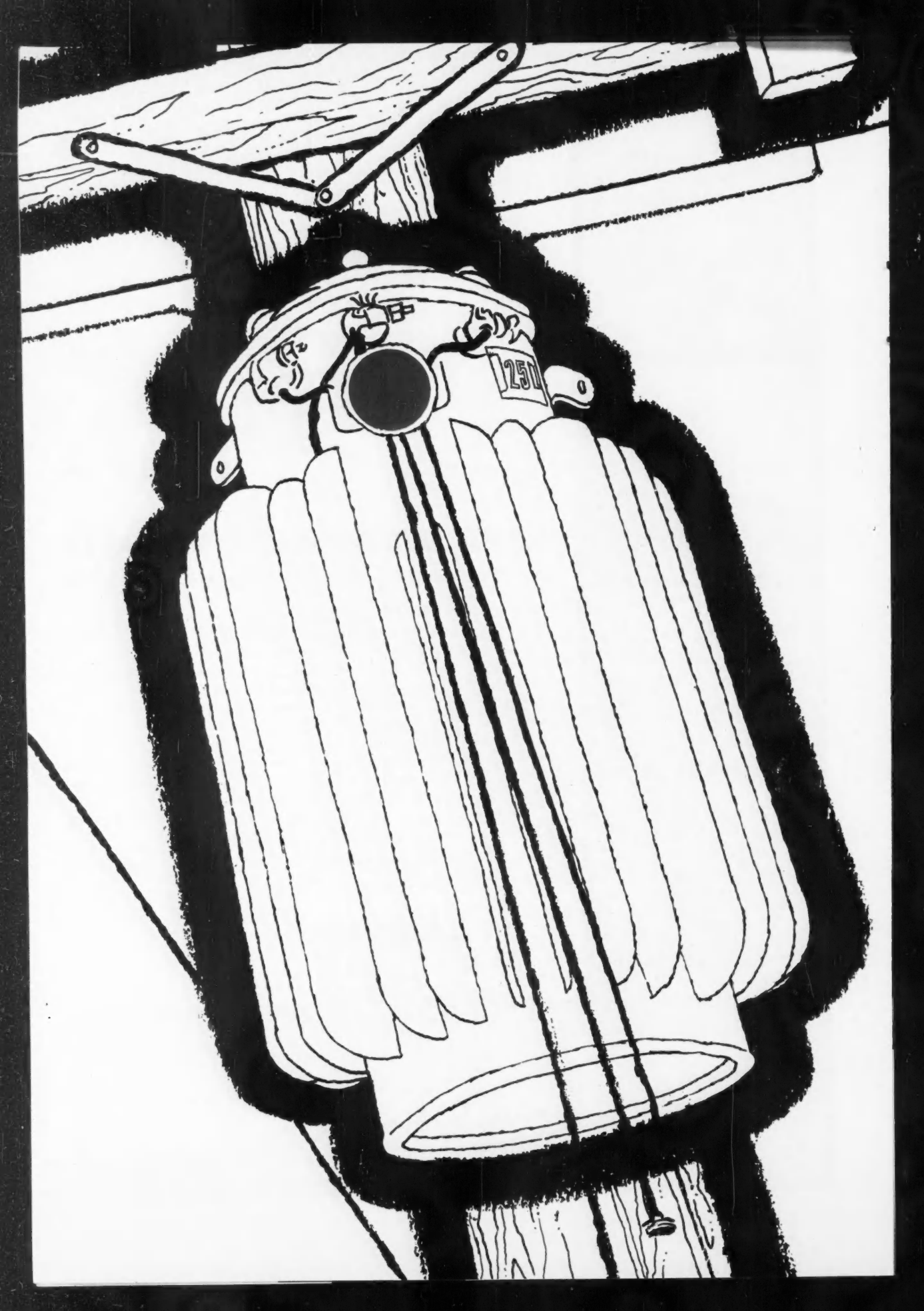
Where else can you get so much for so little cost? Better look into it.

Lapp Insulator Co., Inc., Le Roy, New York.

Lapp



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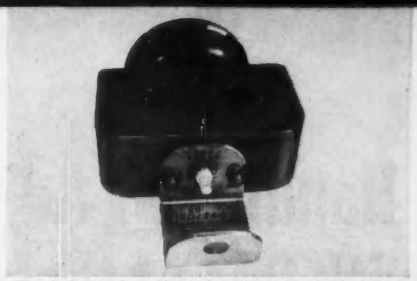
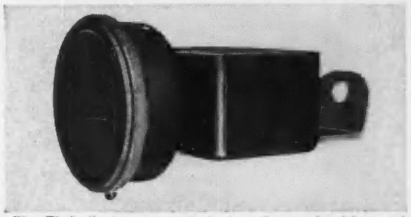


The indicator is calibrated and set at the factory to operate on 60-cycle systems at the center of its range. The indicator can be reset, however, to suit conditions which past practice demonstrates to be unusual.

NEW WESTINGHOUSE TL INDICATOR TELLS WHEN DISTRIBUTION TRANSFORMERS SHOULD BE CHANGED OUT



The TL indicator responds to transformer load in much the same fashion as a conventional demand meter and with approximately the same sensitivity. Economically significant load peaks cause it to respond, but short load "spikes" leave it unaffected. The signal light operates at a predetermined load level which can be field adjusted.

Now You Can Determine Economic Transformer Load Limits Across Your Entire System . . . Economically, Accurately and Rapidly

Proper loading of distribution transformers has long been a major utility operating problem. Underloading results in unnecessarily high capital investment, while overloading yields high operating costs and poor voltage regulation. The Type TL Load Indicator, developed by Westinghouse, now effectively opens a tremendous new area for operating cost reduction and the lessening of revenue losses.

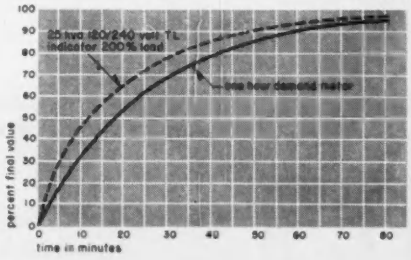
How Does This New Development Affect Load Management? Existing methods of system load measurement have been able to substantially protect you from transformer burn-outs. On the other hand, load checks based on incomplete load data or other types of indicators that require shop installation have not permitted accurate or rapid enough determination of the point at which you are no longer benefiting economically from the extra capacity which we build into our transformers. In fact, it is quite possible that you are operating in the area of loss loading long before the condition is recognized.

With the TL, it is now possible to economically, accurately and rapidly determine economic load limits across your entire system, and to determine whether the existing transformer should be replaced by a larger kva rating or an additional transformer.

Is the TL Adaptable for Your System and Equipment? The Type TL indicator is designed for economical, flexible application to either new or existing transformer installations. The TL can be mounted directly on the low-voltage neutral grounding pad provided on all distribution transformers built in the last 25 years. To install, it is only necessary that the two line leads of the low-voltage secondary pass through the openings in the back of the indicator case.

J 70936

Your Westinghouse representative will be glad to demonstrate and discuss the new TL indicator with you. Or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.



The TL indicator is adjusted for a demand interval of about one hour. This means that if a steady state load is applied, the contact arm will deflect so that it reaches 90% of full value in one hour. If the load is continued, full deflection is reached in about two hours.

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV ALTERNATE FRIDAYS

Handle Any Adjustable-Speed Job with One of these Square D "packages"*

One of 13 CUSTOM DRIVES for an automotive plant for control of 6 miles of monorail conveyors

**a Square D "package" includes the power conversion unit, operator's station, and drive motor*

No matter what adjustable-speed requirements you may have, you can select a Square D drive to meet them exactly. Moreover, every component—from control to drive motor—is subjected to a complete electrical test, and the entire drive is test-run at the factory to assure top performance on the job.

***Write** for complete details. Ask for Adjustable-Speed Bulletin. Square D Company, 4041 North Richards St., Milwaukee 12, Wis.*

ELECTRONIC DRIVES

employ advanced designs using more static elements and less tubes. Fail-safe circuits prevent motor runaways. Available in sizes from 1/20 H.P. through 40 H.P.

STATIC POWER MAGNETIC AMPLIFIER DRIVES

provide top reliability and simple maintenance. Save both floor space and weight as compared to conventional drives. Available in sizes through 400 H.P.

MOTOR-GENERATOR DRIVES

use static regulators and rectifiers for simplified maintenance. Rugged, heavy-duty components are provided in each drive. Available in sizes through 400 H.P.

CUSTOM DRIVES

for every possible adjustable-speed requirement can be designed for you using combinations of the above units, plus special units, with accuracies to fractions of 1%. The answer to your adjustable speed problem is as near as your Square D field office.

SQUARE D COMPANY

wherever electricity is distributed and controlled

U. P. GENERATING COMPANY FOUND A WAY TO BE SURE
OF CHOOSING THE RIGHT TURBINE OIL

They selected NONPAREIL —the only oil with life-of-turbine guarantee

Situation: In 1955, Upper Peninsula Generating Company installed a 22,000 kw General Electric turbine in its Presque Isle station. When lubricant for this turbine was chosen, U. P. management elected to install an oil with a life-of-turbine guarantee—NONPAREIL.

But that wasn't all plant management received when the decision was made to buy NONPAREIL Turbine Oil. In addition, Duane Johnson, Standard Oil lubrication specialist located in Marquette, made a complete lubrication survey of the entire plant. He provided technical service on lubrication during construction and after operations started.

What has happened: In the four years since installation, the turbine has performed satisfactorily without any lubrication difficulty. In a routine inspection a year after installation, the bearings proved to be in excellent condition. Periodically samples of the oil have been removed for analysis at Standard Oil's Whiting laboratory. The oil remains in its original excellent condition.

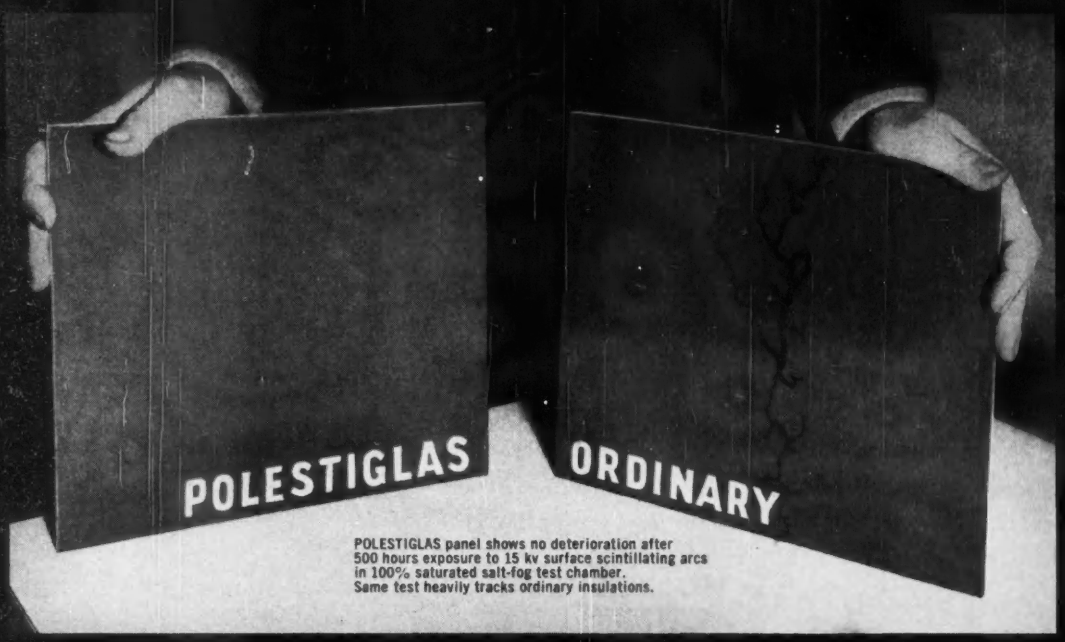
What you can do: Get this life-of-turbine guarantee on the turbine oil you install by specifying NONPAREIL. Call the lubrication specialist in the Standard Oil office near you anywhere in the 15 Midwest or Rocky Mountain states. Or contact **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from STANDARD *and you get it!*

Standard Oil lubrication specialist Duane Johnson (left) and station chief engineer Charles York, inspect 22,000 kw G-E turbine at Presque Isle station. On lubrication jobs of this kind Duane Johnson is well qualified to provide technical service. He has an engineering degree from the Michigan College of Mining and Technology plus 10 years' experience with Standard in this work. He has also completed Standard's Sales Engineering School.

Quick facts about
NONPAREIL
TURBINE OIL

- Will not permit formation of harmful acids
- Will not permit formation of sludge or oil varnish
- Will maintain good demulsibility or water-separating characteristics
- Has high resistance to foaming
- Contains adequate rust inhibitor



POLESTIGLAS panel shows no deterioration after 500 hours exposure to 15 kv surface scintillating arcs in 100% saturated salt-fog test chamber. Same test heavily tracks ordinary insulations.

FEDERAL PACIFIC ANNOUNCES...

POLESTIGLAS*

IMPROVED INSULATION FOR METAL-CLAD SWITCHGEAR RESISTS TRACKING... GIVES NEW PROTECTION IN HIGH HUMIDITY AND CONTAMINATED AIR!

Integral casting of POLESTIGLAS (right) assures uniform bus insulation and eliminates hand-wrapped bends and offsets. Insulation is bonded to the bus bar to give void-free construction resulting in low corona loss.

Po•les•ti•glas...a cast or molded glass reinforced polyester...Provides superior insulation for metal-clad switchgear...Licks "problem" installations too tough for conventional insulation...Proves best insulation for use in areas of high humidity and contaminated atmosphere. **TEST RESULTS SHOW:** ■ Superior resistance to tracking ■ Reduced moisture absorption ■ Low, stable power factor in high humidity ■ Greater flame retardance ■ Low corona loss ■ High dielectric and impact strength. POLESTIGLAS ...another engineering achievement in Federal Pacific's program to better serve utilities and industry. Write for Bulletin 6025, Federal Pacific Electric Company, General Offices: Department 374, Newark 1, New Jersey.

*Trademark of Federal Pacific Electric Company

FPE **FEDERAL PACIFIC ELECTRIC COMPANY**

The Best in Electrical Distribution and Control Equipment

The Electrical Week

FUTURE NEWS ▶ **Tone and direction of 1960 public power line likely will be set** in meeting next week sponsored by Electric Consumers Information Committee Program includes "plan-for-action" talks by Clyde Ellis, NRECA; Alex Radin, APPA; and Sen Frank Moss.

LATE NEWS ▶ **Interconnection of Ohio municipal and co-op systems** was objective sought in Norwalk meeting last week. Representatives of about 15 systems slated another session to form a committee which would strive for tielines between neighboring cities at first, and a state-wide grid ultimately.

Kentucky Utilities is offering increased tax payments to cities it serves. Cities will receive 3% of KU revenue from residential and commercial customers if new 20-year franchises are approved. Total KU outlay would be $400,000 if all cities accept.

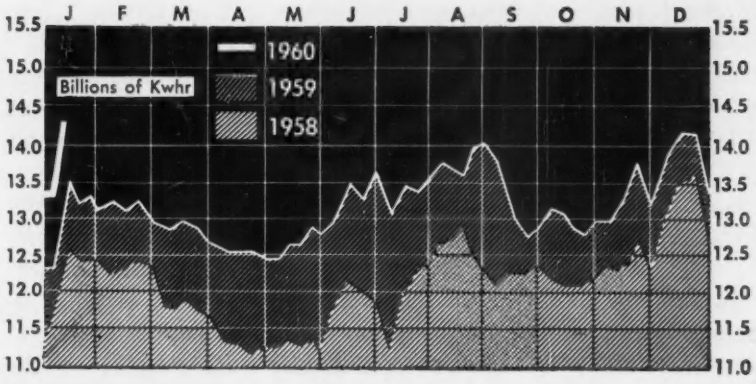
Power is produced by high-temperature cesium cell converter in frequency range of 100 kc. This was enough to illuminate a series of small light bulbs without use of rotating machinery or dc-ac converter. Test is backed by nine power companies, General Dynamics.

Bonneville Power Administration had $6-million deficit for power operations in fiscal 1959, a recently released report reveals.

Richvale Irrigation District seeks FPC license for four dams of 200 Mw on Middle Fork of Feather River in California. Cost of projects would be about $120 million. Pacific G&E would buy entire output.

Outage in Orange, N. J., was caused by 4-kv paper-lead cable fault, and oil circuit breaker's failure to clear it, Public Service E&G says. Jan. 7 incident lasted 8 hr, affected 22,500 customers.

***WEEKLY POWER OUTPUT*—Up 5.6%** (Week ending Jan. 9), Kwhr 14,309,000,000
Up 9.7% (Week ending Jan. 2), Kwhr 13,565,000,000



Per Cent Change From Previous Year

	Dec. 26	Jan. 2	Jan. 9
Total U. S.	+ 7.8	+ 9.7	+ 5.6
New Eng.	+ 6.4	+ 6.0	+ 1.5
Mid. Atlan.	+ 8.5	+ 8.7	+ 6.0
Cent. Ind.	+ 9.0	+10.7	+ 7.1
West Cent.	+ 4.8	+ 7.9	+ 3.1
Southeast	+ 5.7	+ 7.7	+ 3.1
South Cent.	+ 8.8	+10.7	+ 6.7
Rocky Mount.	+ 3.4	+ 8.4	+ 2.6
Pacific			
NW	+ 7.2	+13.8	+ 2.1
SW	+13.9	+13.8	+14.5

Seasonally Adjusted Index 261.7
Week Ago 264.2 Year Ago 248.6

Source: Edison Electric Institute

Preview of This Issue

EVENTS ▶ **What issues will utilities face in Washington this year?** The answers to this question, measured against a Presidential election year background, are outlined on **page 40** . . . "Sourcing"—the subcontracting by electrical manufacturers of work to foreign firms—is at the heart of a flare-up over the Glen Canyon turbine contract **(p 41)** . . . REA sales up 15.5% **(p 42)** . . . Mild weather shaves winter peaks **(p 42)** . . . A renaissance for electric vehicles? **(p 44)** . . . Transmission design for Kariba project emphasizes lightning protection **(p 46).**

ENGINEERING ▶ **The nation's first 460-kv transmission line is under construction.** The prototype, which will traverse the 13 miles between Saxton and Claysburg in south-central Pennsylvania, will be energized by Penelec this summer **(p 47)** . . . Computer-supervised controls will improve reliability and operating economy in Southern California Edison's Huntington Beach No. 3 and 4 units. Specific improvements expected include increased safety, reduced unit outages, and reductions in fuel, manpower and maintenance costs. These advantages are expected to outweigh the additional cost of $1.2 million per unit **(p 51).** **(Correction:** The "Next Week" item in last week's summary erroneously credited this automatic station to Pacific Gas & Electric Co.)

Politics and Public Power

A MATTER FOR CONGRESS AND THE COURTS

The new Internal Revenue Service regulation on expenditures for advertising, promotion and lobbying is still unclear . . . and so the controversy will go on.

The IRS has adopted without change the new regulation, following open hearings. As in the ECAP case before the Federal Power Commission, businessmen, trade association officials and labor leaders will have to go to higher authority for relief. That authority will have to be the courts and/or Congress.

FPC practically invited a court test of its position on how to handle advertising costs —such as those involved in the ECAP program—for rate-making purposes.

IRS, on the other hand, is inviting the affected parties to get relief from Congress. Commissioner Dana Latham says he wants Congress to straighten out the mess, and it's expected he would testify in favor of new language covering advertising.

Rep Hale Boggs (D-La.) has introduced a bill that would exempt from taxes contributions to advertising classified as necessary business expenses.

Washington observers speculate that the newspaper publishers and advertising agencies will take the lead in pushing for the new legislation, rather than the businessmen, labor leaders and others whose contributions are affected. However, chances look small for a law being voted this year.

The new rule disallows deductions from taxable income of expenditures for promotion or defeat of legislation and political candidates, including "the cost of advertising to promote or defeat legislation, or to influence the public with respect to the

PROCUREMENT & PRODUCTS ▶ **Liaison between procurement and engineering is paying off** for one big space research firm. Idea may have possibilities for utilities **(p 71)** . . . Allis-Chalmers ships 250-ton stator to Houston L&P . . . GE develops smaller, lighter 5-kvar capacitor . . . I-T-E will supply 141 HV switches for Niagara Project **(p 72)** . . . Metalclad switchgear is rated as high as 44,500 amp fault closing and 500 Mva short-circuit interrupting . . . Hydraulic derrick has rectangular legs and extra long middle leg hydraulic cylinder for high strength **(p 76).**

MANAGEMENT ▶ **Residential construction is heading down as we enter '60; indeed,** it is the only segment of business doing so. What's the trouble . . . and what are the consequences and implications for the electric utility industry? For a penetrating rundown on the problem, turn to this week's Electrical Business Outlook on **page 81.**

SELLING ▶ **Heat pumps grow green oats year 'round, boost milk production on** Alabama farm. The units—two 1-hp jobs—are used in a green food-producing incubator **(p 88).**

NEXT WEEK ▶ **Part I of EW's 56th Annual Statistical Report** will be published. Be sure to see this 16-page detailed picture on electric utility budgets.

desirability or undesirability of proposed legislation . . . even though the legislation may directly be the taxpayer's business."

Critics say the IRS has failed to clarify anything, including a determination of how the allocation of dues or contributions from unions or associations will be made.

EVEN GREATER SUCCESS

Members of Congress and other spokesmen in Washington are going to find it even harder to plead poverty in 1960 as a means of representing their rural electric co-op interests than they did in 1959.

The story covering the Rural Electrification Administration's 1959 year-end report on page 42 tells why.

Almost every indicator of utility growth for the REA borrowers was substantially increased during '59, with correspondingly greater implications for what is happening down on the farm. As REA Administrator David Hamil put it, "The rise in the number of rural consumers and the demand for more electric power by those already on the lines are signs of the many changes taking place in rural America. More and more farmers are using electricity to handle farm chores automatically. Rural business and suburban developments are on the increase, too. Five out of six consumers added to REA financed lines in the continental U.S. during 1959 were non-farm consumers."

This means, of course, that it may be harder to defend 2% money for rural co-op loans. It might lend impetus also to proposed tax reform measures for cooperatives. There isn't much chance that these things will come to pass in a Presidential election year, but it will be interesting to watch the candidates make political fuel of them.

Nuclear Notes

AEC signed a long-awaited contract for a nuclear superheat power reactor, last week, with Puerto Rican Water Resources Authority, a public power organization. General Nuclear Engineering Co, headed by Dr Walter Zinn will build the boiling water nuclear superheat reactor. Under the joint project, AEC will spend $11 million on the nuclear portion of the plant and PRWRA will provide for a part of the conventional generating equipment and bear fuel costs and operating costs. Site has not yet been disclosed. The reactor has a power output in the 15-20 Mw range. AEC will go ahead with the project on the basis of extensive pre-research and development work that shows the reactor technically and economically feasible.

A status report on the Dresden reactor, out of service since Nov. 6 due to control rod drive difficulties, is to be published "periodically" by GE. It will cover operating characteristics and data. First issue is due in mid-January, also listed as the time when the reactor will return to critical operation.

The California Utility Commission has granted a "Certificate of Convenience" to Pacific Gas & Electric for construction of its $21 million 60 Mw Humboldt Bay atomic plant. PG&E still must get an AEC construction license and the okay of local authorities. The single cycle boiling reactor will be integrated with the company's 100-Mw thermal generating facilities at Humboldt Bay. Construction is to begin in the spring.

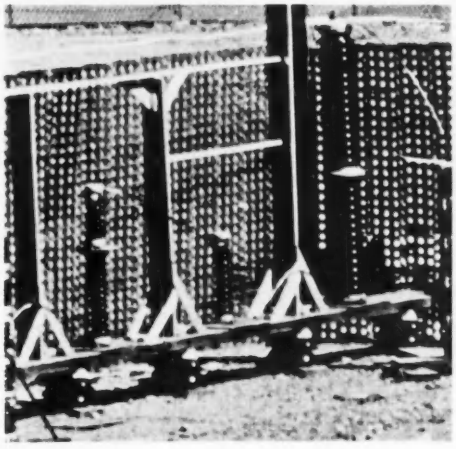
USSR plans to build a 50-Mw fast-breeder reactor power plant on the Volga according to statements of the Soviet fast reactor team which started a week's visit of British facilities Jan. 10. They are visiting the UK's fast breeder reactor at Dounreay, Calder Hall and Harwell.

Dr Leslie Silverman has been elected chairman of AEC's Advisory Committee on Reactor Safeguards. He is professor of engineering in environmental hygiene and director of the radiological hygiene program of Harvard University's School of Public Health. The Committee reviews safety studies and facility license applications and advises the AEC on safety aspects of proposed or existing reactor facilities.

The German Atomics Ministry will shoulder half the construction cost of the 15-Mw reactor planned by AVR, a group of 14 public power supply companies at a cost of $9.5 million. Construction of the high temperature reactor will begin in the spring at the Northrhine-Westphalian Nuclear Research Center and will take about three years.

A symposium on the conversion of nuclear energy directly into usable power will be held March 19-20 by the American Nuclear Society's Pittsburgh section. This is said to be the first time that a meeting of such a national scope will discuss the feasibility of producing usable power directly from nuclear energy.

Still in one piece



Frames from a high speed motion picture showing, successively: venting of gas through the Thorex pressure-relief system at the instant of fault current initiation, clearing of smoke and dust cloud, and the intact housing (far-right) after the test was completed.

Thorex arrester on pressure-relief test survives massive fault current...intact!

Output of several 230-kv transmission lines was added to 75 per cent of the total capacity of one of the country's largest hydro plants to produce the massive fault current used in this test of Thorex arrester internal pressure relief.

Station Class Thorex Type MPR arresters, with internal parts damaged to assure failure, were subjected to a symmetrical rms current of 23,000 amperes which, with offset, gave a 43,500-ampere crest. These arrester housings survived this fault current with all parts completely intact.

Factors contributing to this are (A) Pressure-relief diaphragms, at both ends, larger than the internal diameter of the arrester housing. (B) Direct-acting relief provisions, sensitive to *pressure only,* and functioning in an instantaneous single step. (C) A clear internal path of generous size, not impeded by any circuit parts, passes the rapidly traveling pressure front to the relief diaphragms.

There may come a time when an arrester is expected to fail. When that happens, its ability to remain physically intact can save costly damage to surrounding equipment. Thorex Dynagap Type MPR Station Class arresters have generous safety provisions for such an emergency, demonstrated by severe field testing.

Here is just one more of the many proven reasons why you should specify Thorex Dynagap lightning arresters on your next station construction.

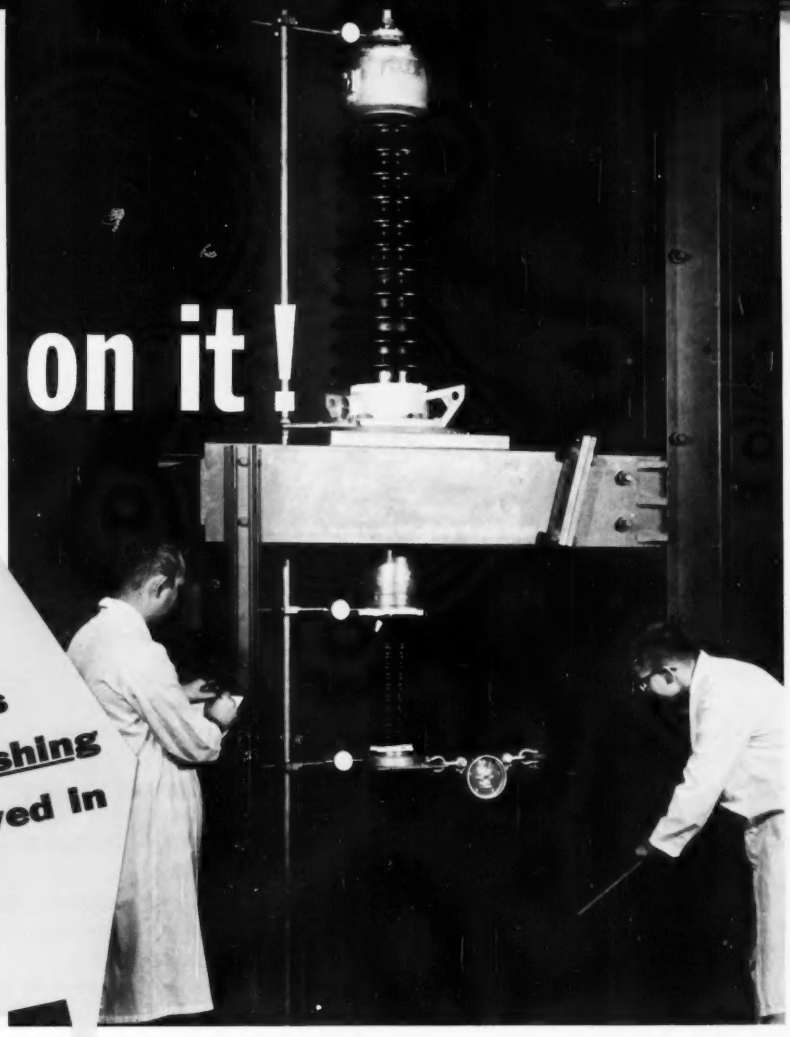
OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10001-H1

Count on it!



O-B assembly practice produces high, uniform bushing strength . . . proved in both laboratory and field

Prolonged laboratory investigation of factory production has proved the high, consistent strength of O-B condenser bushings. Thousands in service confirm it. On this test stand, deflections are read by precision indicators. Gasket joints are painted with whiting to signal oil leakage. Not only does O-B build high, uniform strength into its bushings, but we invest time, trouble, and dollars to be sure of it.

Cantilever strength of bushings must not vary. High, consistent strength is essential, especially in circuit breaker service. Why should it vary - - aren't all bushings exactly alike? The answer is "no".

There are eight separate components in a bushing that are held in end-to-end position by a set of heavy compression springs. Every one of these has its own dimensional tolerance. Chance of selection can produce a sum of tolerances that will vary as much as ¼ inch. This much length variation will materially affect the force expended by the compression springs. Unless there is some adjustment to compensate for this, strength can be quite erratic.

O-B condenser bushings have their spring compression set by dynamometer, independent of their exact length. A threaded flange nut is then tightened against the adjusted springs. Strengths are high, uniform, and permanent.

Not all bushings are built with this care and know-how. Not all bushings are backed with 50 years of experience, either.

When you purchase new station apparatus, remember, the bushings can make it or break it. Therefore, it will pay to investigate just a few details that will assure basically good bushing performance. Or - - and it's easiest - - just ask for O-B bushings and you know you have it.

OHIO BRASS COMPANY, MANSFIELD, OHIO

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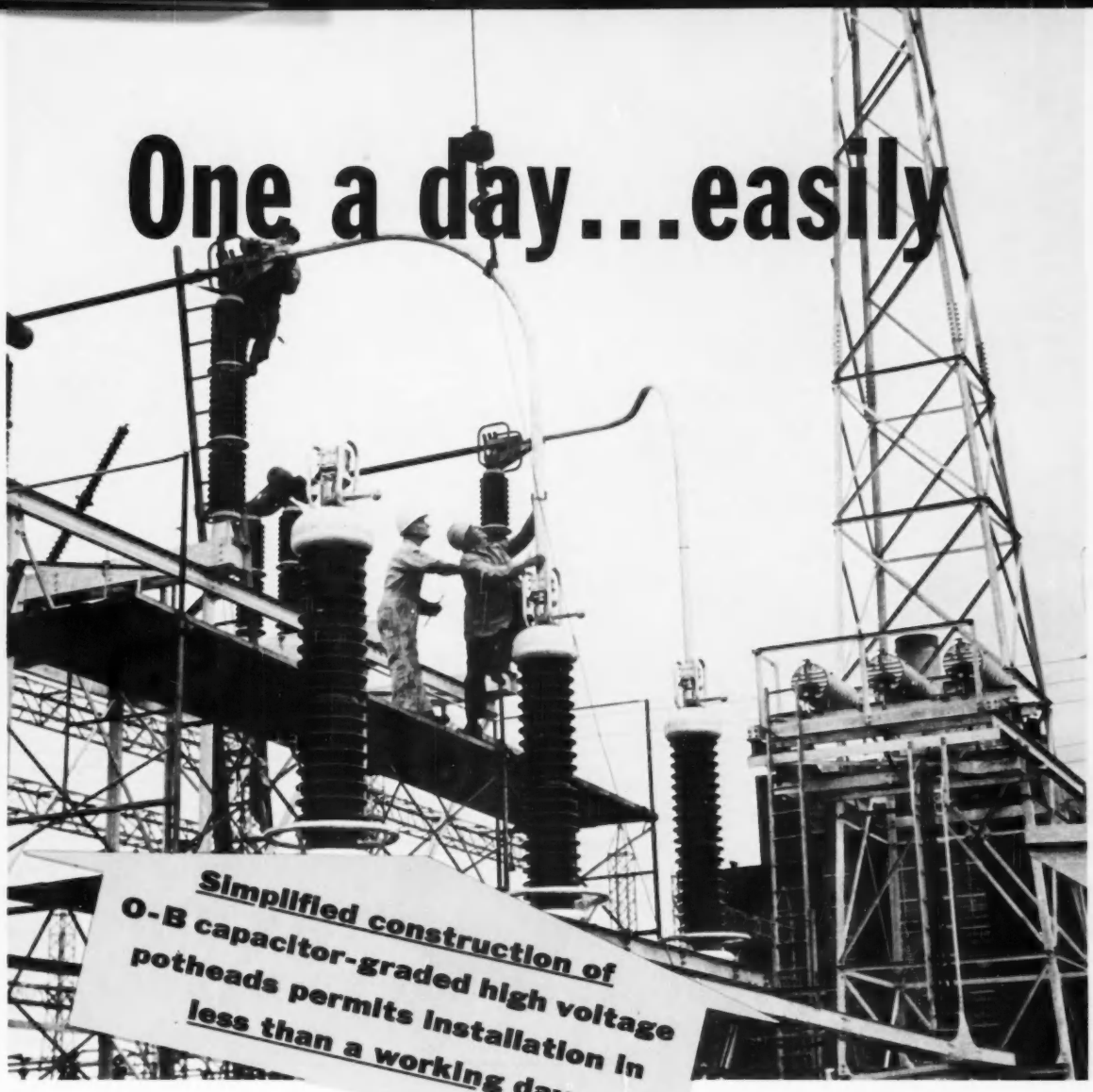
10001-H2

One a day....easily



Simplified construction of O-B capacitor-graded high voltage potheads permits installation in less than a working day

Major parts of the new O-B capacitor-graded pothead are factory-assembled. On the construction site this saves hours of work. It also assures correct, tested assembly of critical components.

Hand work that must be performed has been reduced to a minimum. For example, forming the stress cone, which was once a difficult, demanding field operation, is now an automatic process as part of installing the lower paper buildup. Its high precision is assured. The buildup and stress cone are a factory-built assembly.

Admittedly, a few hours more or less is no cost factor in the lifetime of a pothead, if anything important depends upon it. But, the convenience of the O-B design permits an orderly, unhurried schedule of one a day. Exposure of cable insulation is cut to a minimum. And it reduces those errors that often go with human fatigue.

You can learn from published literature how far advanced is the design of O-B's new capacitor-graded pothead. But you must learn from experience how simplicity gives greater assurance that every detail of this good design will be present in your own installation.

These new potheads are built for all types of cable, 115 kv and above. If you are planning any cable installations, be sure to investigate the new O-B pothead.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass (B) HOLAN

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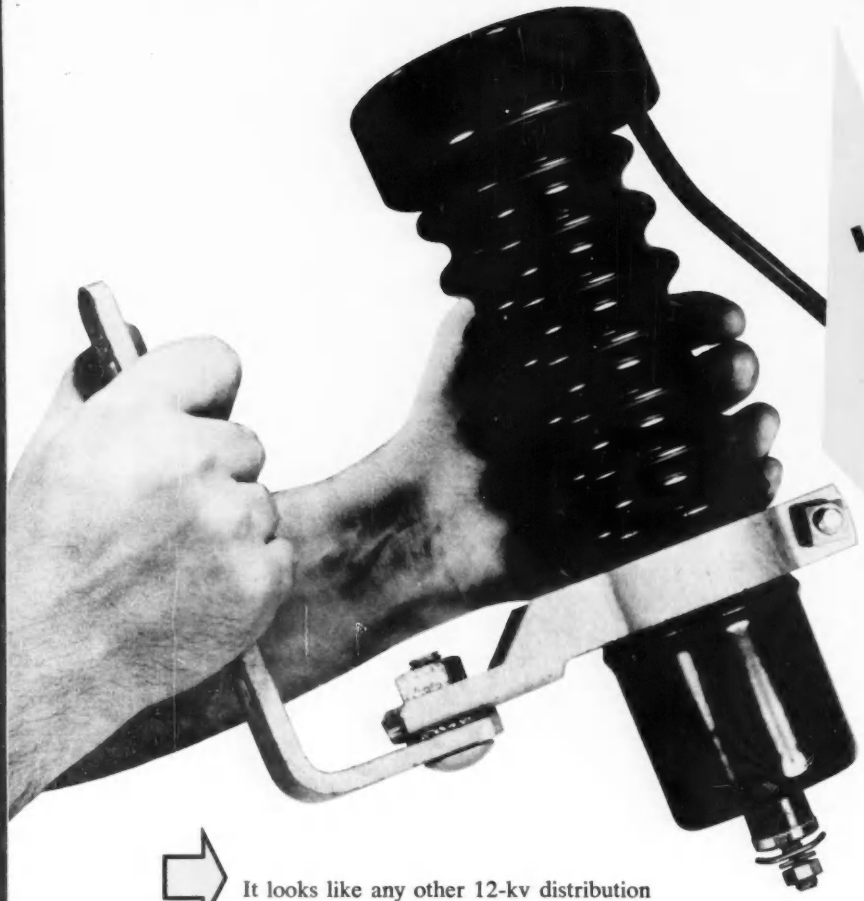
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10001-H3

Small outside...big inside!



If Thorex distribution arresters were as big as their protection... they wouldn't go on top of a pole

It looks like any other 12-kv distribution lightning arrester, except for being smaller. What's so special about the Thorex Dynagap?

ITEM 1: The 12-kv model has 33 inches of arcing length to interrupt power-follow current - - many times that of any comparable arrester. ITEM 2: The above arc is expanded magnetically 100 times its original gap length. Initial sparkover is held to a very low level. ITEM 3: Extremely long arcing length supplies about 50 per cent of resistance requirements for the interruption of power-follow current. This compares to about 2 per cent in conventional arresters. ITEM 4: Since the Thorex valve element is thus relieved of interrupting resistance requirements that once dominated all other factors, a great field of valve block development has been opened. ITEM 5: O-B has taken this opportunity to incorporate heretofore unheard-of thermal durability into its Thorex Dynagap series.

These revolutionary improvements in Thorex arresters result from the interchangeability of many essential parts of the Distribution class with the heaviest-duty station designs. Benefits of this advantage are somewhat dramatic: The 12-kv Thorex distribution arrester has an IR discharge voltage only slightly above some Station Class designs, and a low-current, long-duration durability nearly three times better than the ASA Standard for Station Class. Other Thorex distribution voltage ratings are comparable in all respects.

If Thorex distribution arresters were as big as their protective performance, they wouldn't go on top of a pole! They come in any style you want; pole or transformer-mounted. They cost you nothing extra, and give you a lot extra. Put them to work - - and ask for them on new apparatus.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

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10001-H4

ROEBLING GAS-FILLED CABLE! looks out for your best interests!

Impregnated paper/insulation, with shielding.
Two steel spirals conduct inert gas to all parts of cable to prevent ionization and provide self-supervisory properties.
THE SHEATH ON THIS CABLE . . . is one more reason why it's a best buy! The Tellurium-Lead Alloy Sheath offers the best possible resistance to fatigue and age-hardening problems . . . has 90% less creep, 4½ times greater bending life!
Solid copper tubing is open at splices, assuring constant gas pressure in spiral tubes.
Non-magnetic shielding tape over cable core.

Roebling Gas-Filled Cable (for voltages up to 46 kv) is *self-supervisory!* Super-dry nitrogen gas, inside this cable at approximately 12 p.s.i. pressure, is the key. When gas pressure drops below 10 p.s.i.—or rises above 16 p.s.i.—an automatic signal message is relayed to the nearest attended station. You know when trouble's afoot the second it starts! Repairs can be made *before* serious damage occurs!

Along with this extra *protection*, this cable has properties that lessen the possibility of outages! The inert dry nitrogen gas provides consistent dielectric properties throughout the length of the cable. It prevents ionization, too, and the other problems often associated with solid-type oil-impregnated cable. What's more, it's as easy to splice as solid-type! And if your system includes grades, it may prove to be the most inexpensive cable you've ever used!

Our new Gas-Filled Cable book tells more about this superbly-made cable. It's free—write for it. Electrical Wire Division, John A. Roebling's Sons, Trenton 2, New Jersey.

ROEBLING

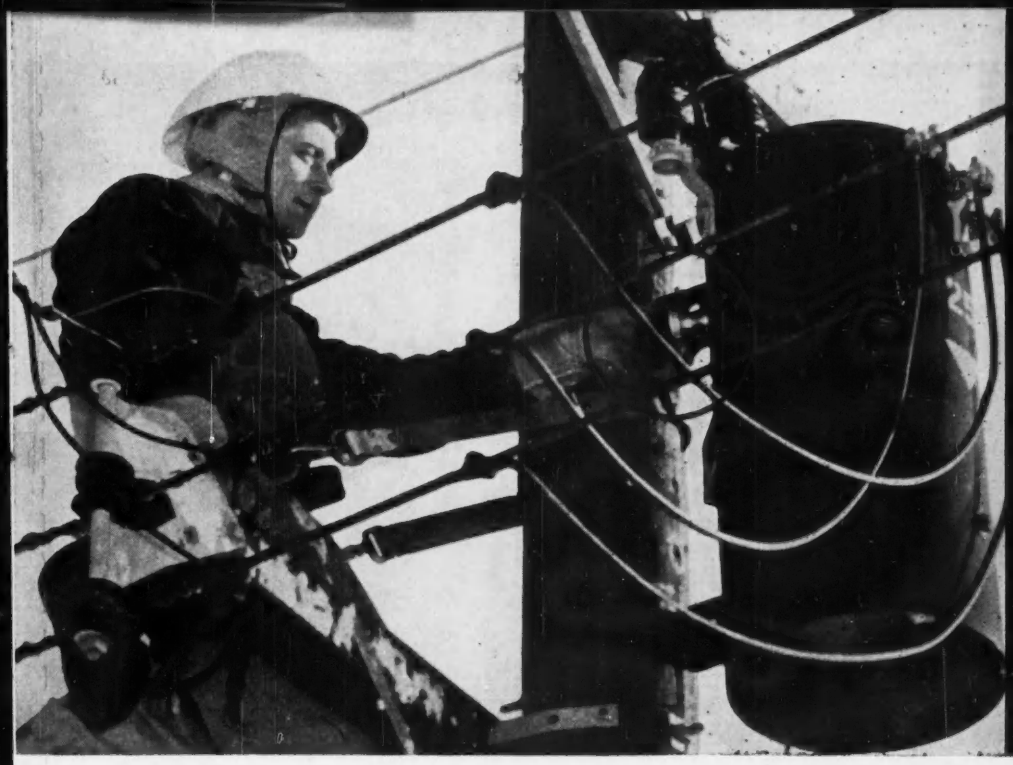
Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

An externally-changeable, bayonet type high-voltage fuse now available on the RT&E Terra-[illegible]. This new fuse now makes replacement of blown fuses a relatively simple p[illegible]ation [illegible] they are removed and replaced without entering the transformer.

INTRODUCING THE RT&E EXTERN-O-SYSTEM

These "EXTERN-O" devices developed exclusively by RT&E are proven and in use today as they point to the completely sealed transformer of the immediate future. You can profit from their use today, their ultimate application tomorrow.

An externally-operated, primary voltage change-over switch, introduced first by RT&E almost three years ago on its dual-voltage transformer. Thousands of these switches are in use on dual-voltage transformers, saving utilities money in labor time, change-over time and transformer replacement cost.

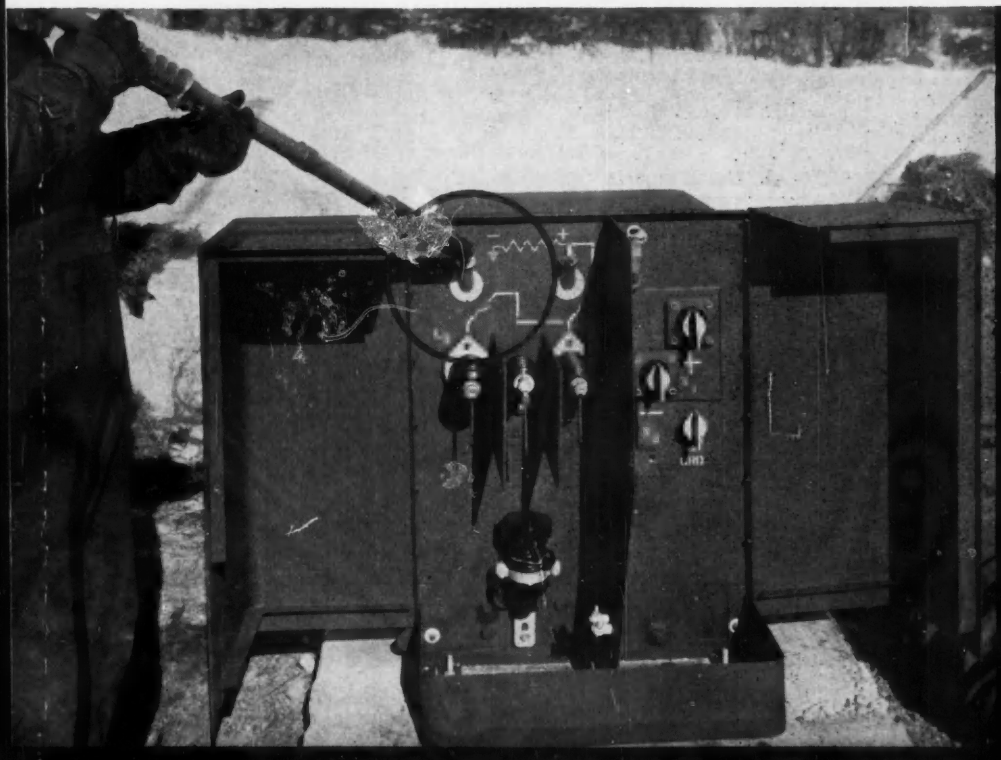


A safe, proven, externally operated tap changer made only by RT&E. With it, there is no handhole cover to remove, less danger on pole during service, no tap setting confusion, no oil contamination and fewer exposed parts to corrode.

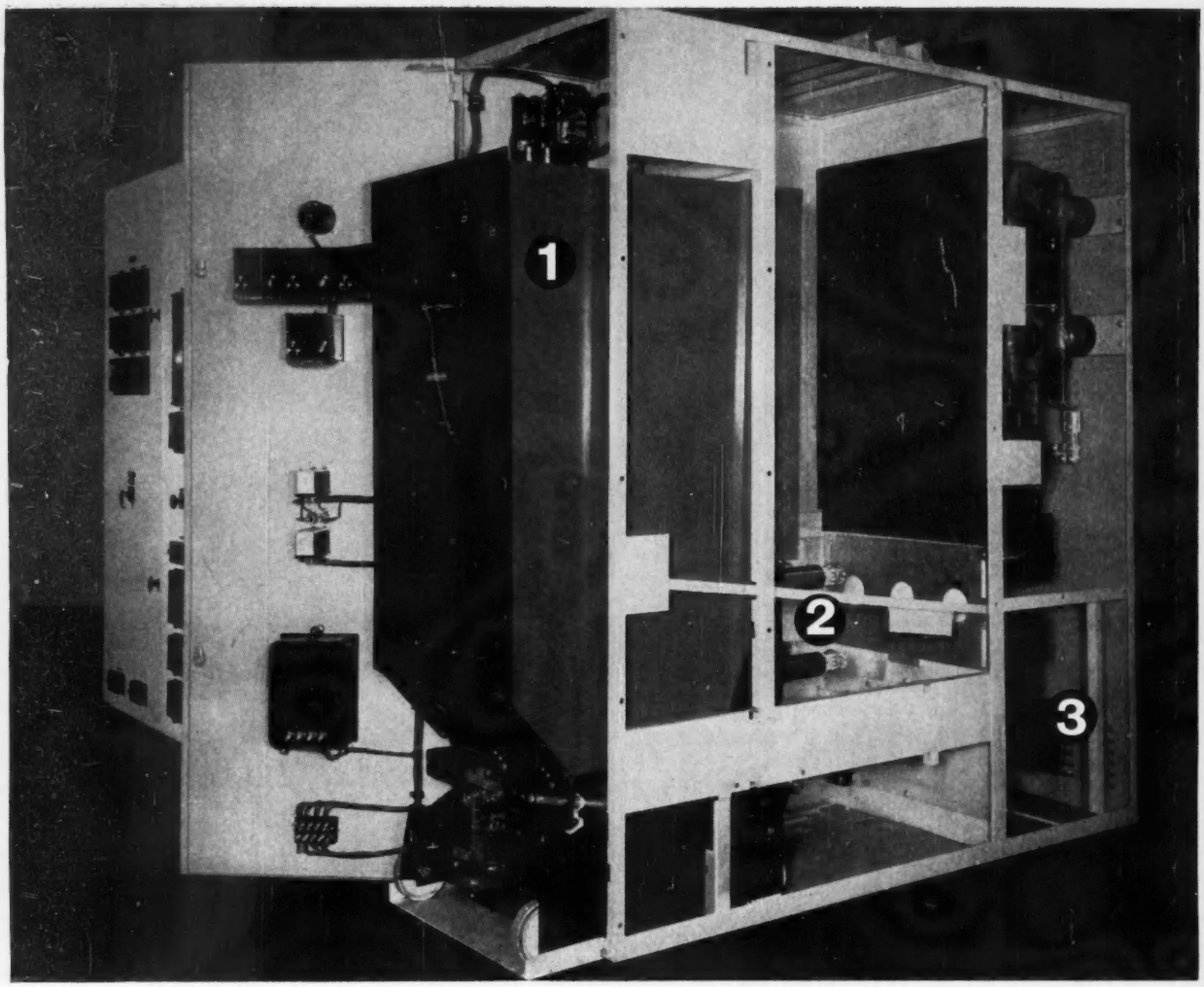
THE WAY TO A COMPLETELY SEALED TRANSFORMER

Reduce operating and maintenance costs, increase personnel safety. Eliminate entering the tank, prevent oil contamination, extend life of the transformer.

RT&E CORPORATION • Waukesha, Wisconsin • Portland, Oregon



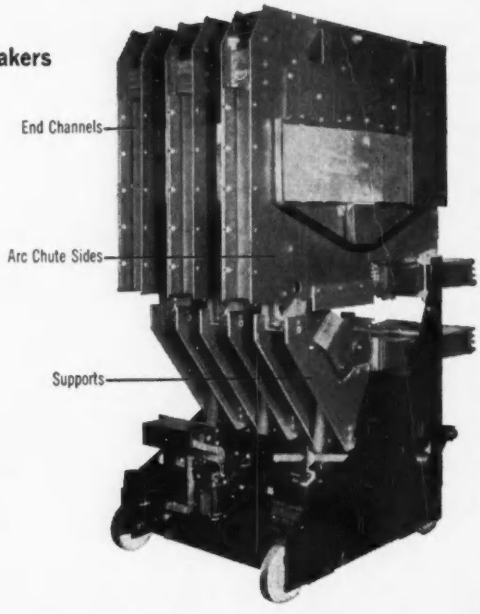
An externally-operable bayonet type disconnect switch now available on the RT&E Terra-Tran. With it, line sectionalizing for quick and easy isolating of faulted transformers or faulted cable is easily carried out.



1 **"Limitrak" Glass Polyester Insulation on DH Breakers**

2 **"Limitrak" Coating on DH Breaker Bushings**

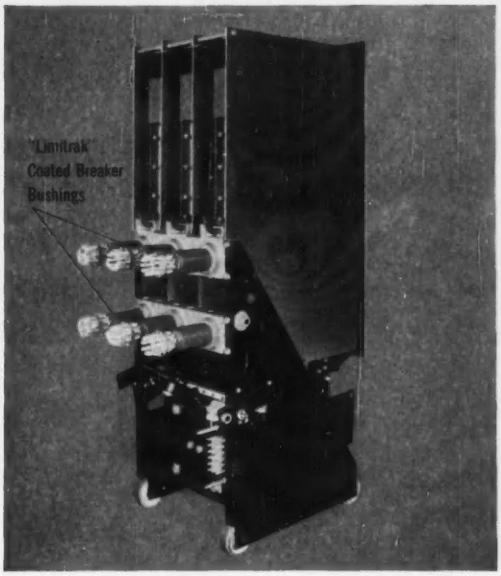
3 **"Limitrak" Design Porcelain Bus Supports**



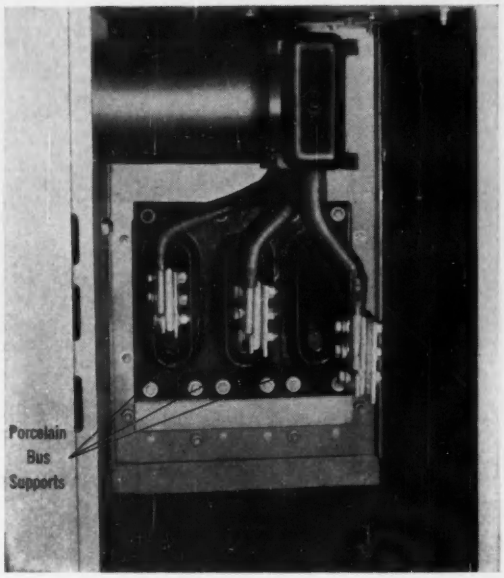
"Limitrak" Glass Polyester Insulation is used for arc chute sides, end channels and supports on DH breakers. Tests have proved it 300 times more track-resistant than ordinary glass polyester materials.

BONUS VALUE BEYOND SPECIFICATION FROM WESTINGHOUSE

"LIMITRAK"–THE EXCLUSIVE NEW WESTINGHOUSE INSULATION . . . provides superior, balanced protection in metal-clad switchgear



"Limitrak" Coating for insulation bonds itself to other basic insulating materials such as phenolic insulation. An exclusive compound developed by Westinghouse, "Limitrak" coating raises the track-resistant characteristics of phenolic materials to a level equivalent to "Limitrak" glass polyester insulation.



"Limitrak" Design provides greater-than-ever track-resistant surfaces on porcelain insulating components. Exclusive "Limitrak" design of this vertical bus support, for example, minimizes accumulation of potentially conductive materials–provides maximum phase-to-phase and phase-to-ground fault protection even in moisture-laden atmospheres.

Westinghouse developments in insulating materials and design are combined in the exclusive new Limitrak® insulation system which offers users a superior, balanced level of protection in Westinghouse metal-clad switchgear.

"Limitrak" Glass Polyester Insulation is a new track-resistant material developed by Westinghouse. It is used for sheet and molded shapes in metal-clad switchgear. Tests have proved "Limitrak" to be 300 times more track resistant than ordinary grades of glass polyester–and 1200 times more track resistant than phenolic material. "Limitrak" is also highly flame retardant.

"Limitrak" Coating for insulation, used on DH breaker bushings, combines the track-resistant characteristics of "Limitrak" materials with the high dielectric strength and characteristics of all Westinghouse bushings. This coating can be applied to carefully cleaned insulation on existing equipment to provide better-than-new resistance to tracking and moisture absorption.

"Limitrak" Design, incorporated in procelain insulation components such as vertical bus supports used in metal-clad cells, provides superior track resistance since this one-piece vertical design eliminates hidden creepage paths.

Get the complete story on the superior, balanced protection you receive in Westinghouse metal-clad switchgear with the exclusive "Limitrak" insulation system. Call your Westinghouse representative.

J-60974

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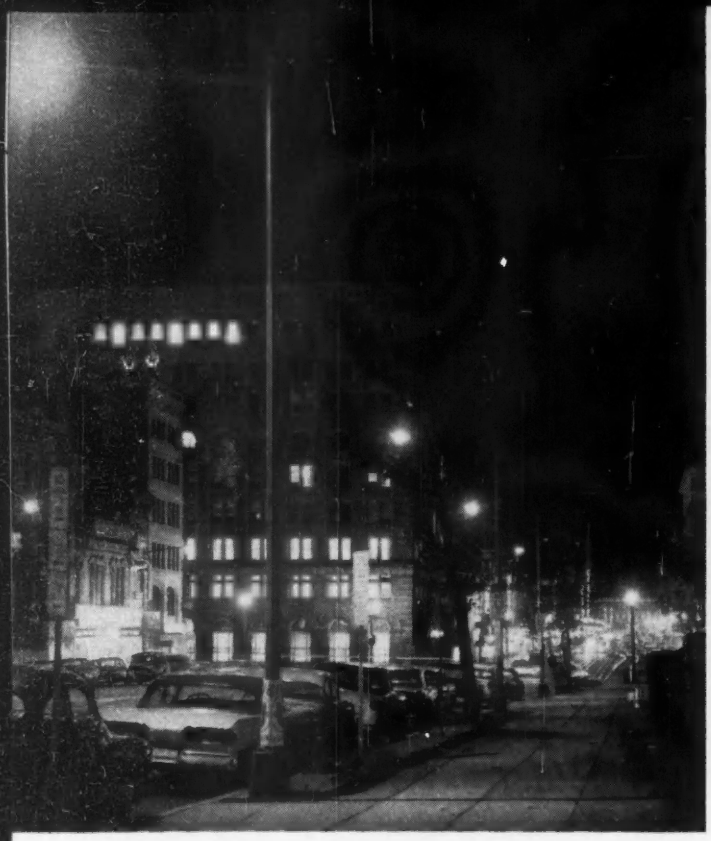

F-P Sent to Washington ...Capital Gains

PEPCO REPORTS DEPENDABLE OPERATION WITH MERCURY VAPOR LAMPS, NO FALSE TURN-OFF FROM HIGH AMBIENT OR LIGHTNING

Potomac Electric Power Company now has in operation several thousand Fisher-Pierce Series 6600A controls, the majority on mercury vapor luminaires fed by underground 120-volt secondary lines. Despite the fact that Washington is an area of many thunderstorms, there have been no reported cases of turn-off by light from lightning flashes. The Fisher-Pierce controls have also proved particularly useful in areas with nearby bright lights, since the directional design of the control permits orientation away from electric signs and other sources of strong artificial light.

PEPCO first began using Fisher-Pierce controls in 1957, and the number has grown until now F-P Series 6600A's comprise approximately 45% of all the individual controls in PEPCO territory — the District of Columbia and nearby areas of Maryland and Virginia. As the photos indicate, the variety of locations necessitates installation flexibility as well as dependability in the photo-electric controls.

GRAY COLOR and compact design of the 6600A Series control matches the modern PEPCO streetlight poles. All downtown structures in Washington—including streetlighting equipment—must meet rigid appearance standards.

PROGRESS IN WASHINGTON

Incandescent series streetlights are being replaced by new mercury vapor types, individually controlled by Fisher-Pierce 6607A models. The short time delay permits fast checking of the control. Below, PEPCO Mechanic E. E. Mayfield explains control installation to Junior Mechanic C. F. Madigan.

For complete design information and specifications on Series lighting controls, write The Fisher-Pierce Co., 6 Pearl Street, South Braintree 85, Massachusetts.

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PHOTOELECTRIC LIGHTING CONTROLS

AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

Your new power plant or expansion idea

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Capacity adequate?

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Timely?

Kaiser Engineers designs and builds a wide variety of power plants and nuclear facilities.

Among KE's most valued services are sound, searching economic analyses, feasibility studies and site evaluations. In a word—*Pre-Engineering*—impartial, outside analysis which helps you decide whether to proceed with, defer or modify the project.

Kaiser Engineers offers you cost-saving, time-saving, one-company service from concept through start-up.

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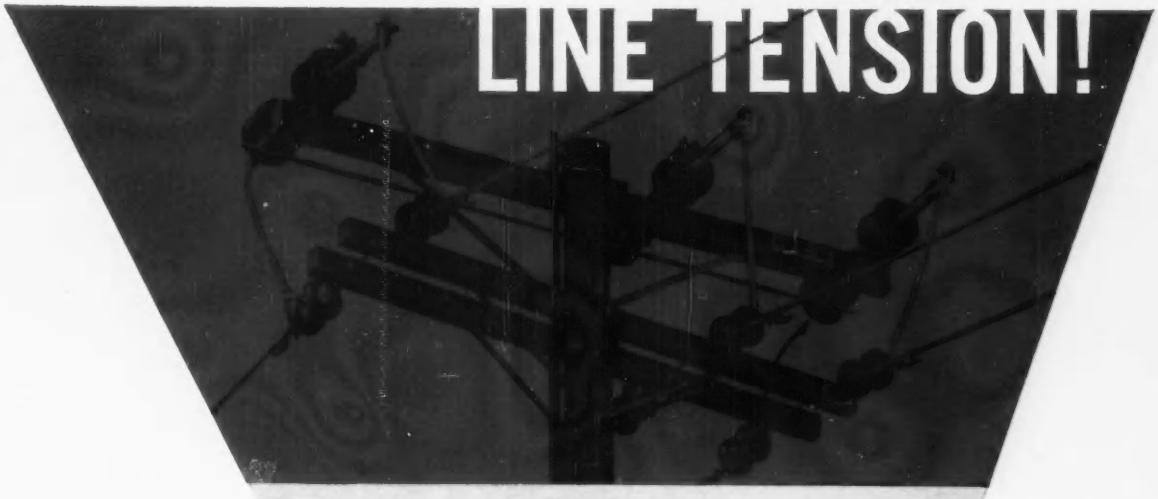
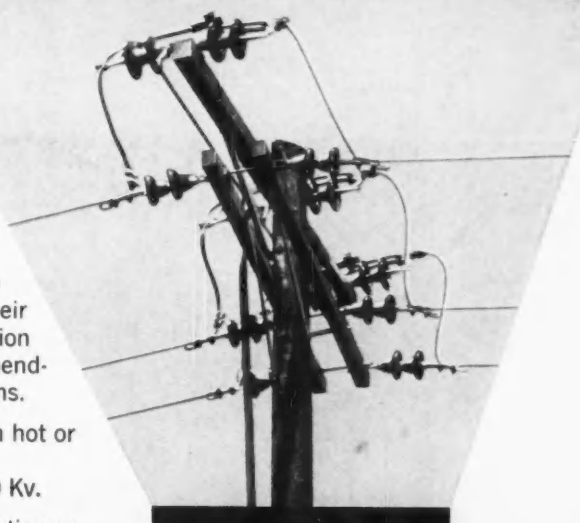
• KE projects include work in Ghana, Japan, Puerto Rico, Vietnam, as well as the United States. They encompass such diverse assignments as nuclear fuel analysis, a nuclear research center, plutonium production reactor, steam-electric power station and a hydro-electric plant.

5459-P

INSTALL KPF SWITCHES WITH OR WITHOUT LINE TENSION!





KPF air break switches operate equally well with or without conductor tension—tension is not necessary to their smooth functioning. Thus KPF switches may be installed on angle poles, major crossings or other locations where separate deadends are desired. Further, their simple design eliminates lubrication or maintenance, and insures dependability under all weather conditions.

KPF switches may be installed on hot or dead lines, and are available for common voltages from 7.5 to 110 Kv.

Test KPF switches with an installation on your own system. Inquire now!

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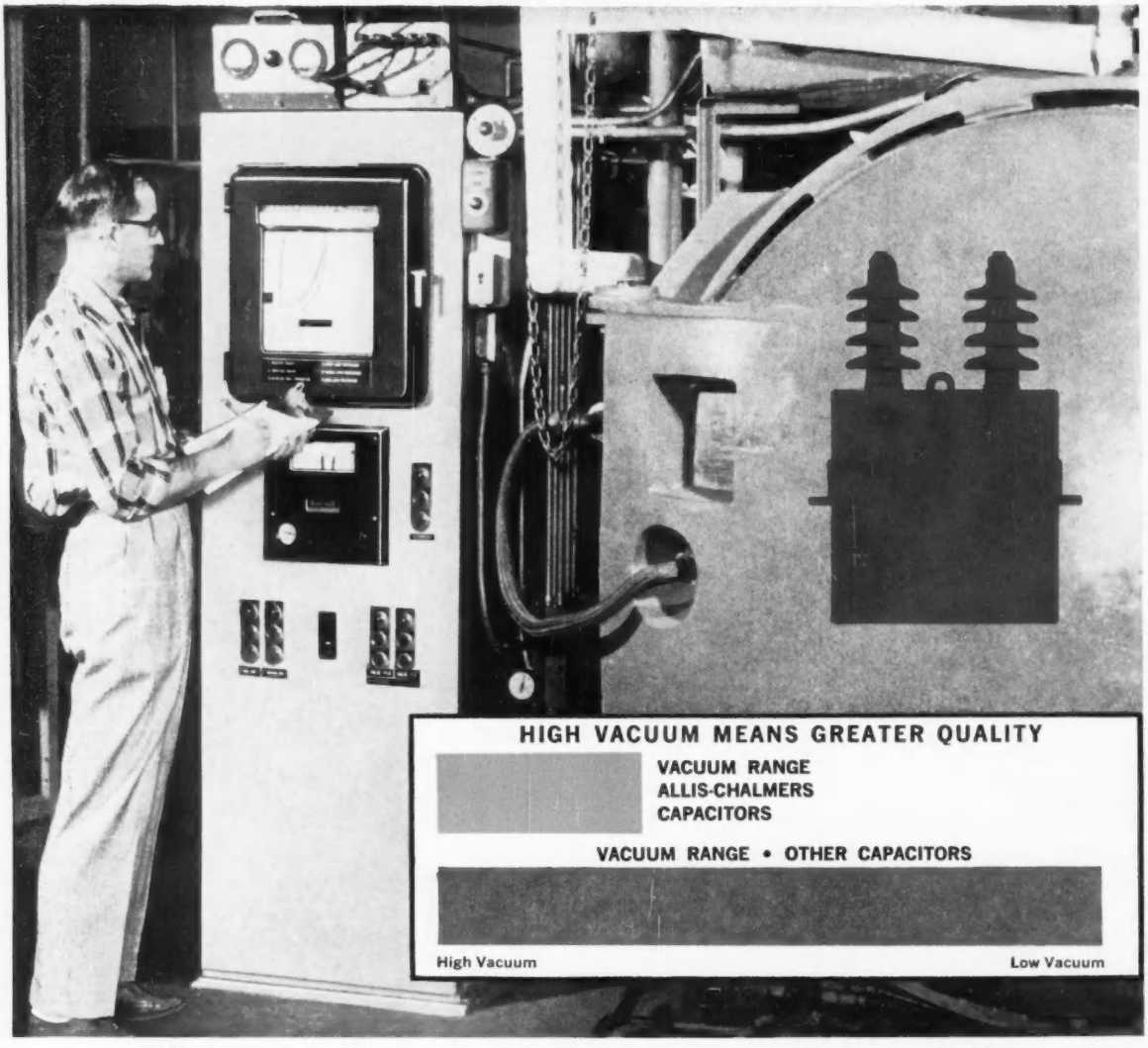

Extra years of capacitor life

through "extra-low" drying and degasification

Why take the trouble to extract air and moisture with high vacuums? This is to guarantee that you get the greatest return from your Allis-Chalmers capacitor dollar!

Better vacuum processing — a carefully controlled combination of heat and extremely high vacuum — means better penetration of the *Chlorextol* insulating liquid into the packs. Insulating paper losses and heating are reduced, electrical strength is gained. Thorough degassing increases voltage level at which corona starts. It all adds up to a big, built-in margin of safety for severe overvoltages and high ambient temperature . . . for *extra* years of capacitor life.

For more capacitor facts, call, wire or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-1220

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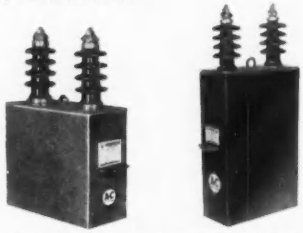


Complete capacitor equipment is available for immediate shipment—25 and 50-kvar units—2400 through 7960 volts. Includes racks, voltage and current controls, other accessories.

Steam Station Automation Advances Another Step

No stranger to either automation or computers for engineering calculations, the electric utility industry has turned recently to process control computers for power system dispatching and steam power plant control. Here most of the computer functions replace those ordinarily performed by recorder-controllers, human operators, clip boards and office personnel. Now station designers promise to go considerably beyond that, in the direction of completely automatic operation.

For many years, steam station operators have relied on automatic controls using pneumatic, hydraulic, electrical and electronic devices to extend their reach and broaden their grasp of operating conditions. Even so, in the modern super-power station there are many complex functions to be performed and conditions to be continuously monitored that today's operators need a sixth sense and superb coordination, particularly during start-up and shut-down. Abnormal operations impose even more critical demands. It takes a clear head, a sharp eye, and a quick hand to size up and take correct remedial action fast enough to forestall a costly outage or serious damage to expensive equipment, or both.

These pressures on station operators today, coupled with demands for improved reliability and lower operating costs, are impelling the industry to further automate its already highly-automated steam plants.

Several degrees, or stages, of automation are worth considering today:

1. Data logging in which several hundred variables are scanned for alarm purposes and to print out selected readings at specific intervals.

2. Computer-logging where, in addition to data logging, equipment may perform extensive calculations to determine needed operating values.

3. Control computer-logging that extends the functions of the computer to control variables involved in the process of start-up, shut-down, and normal operation as well as to diagnose and correct trouble.

4. Introduction of incremental digital computers to replace the conventional sub loops in stage three, as well as other components of the control computer-logger.

5. A future scheme of control that will consider the steam station as a whole, with fuel supply, feedwater, and air directly integrated with load changes.

6. Completely automatic operation of a steam station including direct communications with other units and the dispatcher, and self-scheduling for maintenance, etc.

These stepping stones to the complete automation of steam stations vary widely in complexity. The pace of development today is such that only the last two are in the dream stage. The others are being rapidly integrated into the art of station design or are attainable in the foreseeable future.

One of these pioneer applications is the subject of a major article in this issue. Here the design objectives behind a bold and far-sighted application of the control computer-logging concept to units No. 3 and 4 of the Southern California Edison Co's Huntington Beach station are spelled out in detail.

From this kind of engineering enterprise will come tomorrow's progress. To men who made it possible, the industry owes its stature today.

Politics and Brevity to Mark Congress

Members will close shop in July to make way for conventions. Political fever to run high, legislative output low

One of the shortest and most politically-minded sessions of Congress in many years has opened for business. It is expected to adjourn by early July to make way for the Republican and Democratic Presidential nominating conventions.

This Congress probably will be primarily a sounding board for national and political issues, and in setting the stage for legislation in future sessions.

The first of a series of reports to be submitted to Congress this year has already been turned in—the Senate "subcommittee" report on Soviet power progress. Public power supporters call the report an "official" report by a Senate subcommittee, although the group was basically a delegation of three Senators (all public power minded) headed by Sen Frank Moss (D-Utah), who toured U.S.S.R. facilities during late 1959, and much of the report was written by non-governmental delegates.

This report will generate much heat for federal "new starts" on hydro power projects in the Public Works appropriation bill for fiscal 1961; and it also should revive the dormant resolution (S. Res. 71) of Sen. James Murray (D.-Mont.) to create a two-year study into the needs for new—probably federal—high-voltage nationwide transmission grids.

Later reports due this year include the "Kerr report" on water and hydro power needs in the U. S. through 1980, and a report on the need for a high-voltage transmission intertie between California and the Bonneville Power Administration. The Kerr report should be turned in toward the end of Congress; the intertie study is in February.

Rural electrification issues won't get much past the discussion stage. The Administration isn't expected to make any real drive for private co-op financing, but REA Administrator David Hamil will probably continue to ask for interest payments at the going rate for money. However, no legislation is expected.

Bonneville Bill Passage Unlikely

Sen. Richard Neuberger (D-Ore.) is about washed up in his drive for creation of a valley-type "Bonneville Power Corp". This bill (S-1927) has been criticized by both private and public power supporters. The latter are still opposing Neuberger's stubborn insistance on inclusion in the bill of a paragraph, which would change the present Bonneville preference clause to prevent "geographic concentration" of power.

A federal power contract with Montana Power Co., to supply Yellowstone National Park, will be considered in April or March by the House Government Operations Committee, headed by Rep John Moss (D-Calif.). Moss held hearings on the matter in 1959; he claims that the Interior Department improperly awarded the contract to Montana Power when two would-be co-op suppliers had submitted bids to provide the same service at lower cost.

Interior has countered that it preferred Montana Power's proposed high-line routing (through less scenic country) to the routes proposed by the co-ops. But Interior also has admitted that it made errors in figuring the bidders' rates.

Both the Senate and House are expected to hold more hearings this spring on the "ethical practices" of federal regulatory agencies, including FPC. No legislation is expected on any of the bills introduced to change proceedings before these bodies. FPC Chairman Kuykendahl has testified previously on the matter.

The chief of the Army Engineers has sent to Congress—after several years' study—his recommendations for development of the Columbia River, replacing the Engineers' earlier plan of 1949. The new report gives a boost to Pacific Northwest Power Co's proposed high Mountain Sheep Dam on the middle Snake River between Idaho and Oregon. PNP has filed an application with the FPC to build the 1.75-million kw dam for $178-million. Hearings are expected to get underway during 1960.

The Engineers estimate the project would cost $198-million. Also, the Engineers point out that, although the alternate Nez Perce site —farther downstream on the Snake —would "provide the optimum development" (including the best

A Few Figures on the Washington Political Scene in '60

MURRAY KERR MOSS KUYKENDAHL HAMIL

cost-to-benefit ratio), Nez Perce couldn't be built for from eight to fifteen years, because of the migratory fish problem. The report adds, "The benefits that would be realized from the high Mountain Sheep project during the period of delay would outweigh the economic superiority of the Nez Perce project."

The Asotin and Wenaha projects, recommended in preliminary Engineers' reports, were deleted from the final project. Asotin, (288,000 kw) on the Snake River downstream from Nez Perce, was removed from the Engineers' recommended list until economic justification for its navigation benefits can be found—although the project was termed feasible for power alone. Wenaha (134,000 kw) on the Grand Ronde River, in Washington and Oregon, was knocked out because of a migratory fish problem.

The "Trimble bill" (HR-8), to revise the methods for allocating costs at federal multi-purpose projects, will come up for more hearings this session in the House Public Works Committee. Similar other bills have been introduced in Congress, including one by Kerr (D-Okla.) in Senate debate.

Glen Canyon Bid Controversy Goes to GAO

General Accounting Office to decide 'Buy American' applicability of Baldwin-Lima bid. Decision to affect Flaming Gorge

U. S. manufacturers, hard-pressed by foreign competition, have begun going abroad to get lower-cost components in order to compete successfully on a price basis for government business.

Now, a foreign firm has challenged a U. S. company for going too far—charging that it has bought so many of its components abroad that it no longer qualifies as a domestic firm—and thus has lost its 6% "Buy American" price advantage.

The issue came up for the first time when English Electric Co, Ltd, challenged a bid by Baldwin-Lima-Hamilton Corp to supply eight hydro turbines for the federal Glen Canyon Dam in Arizona—a chunk of business worth upwards of $6-million. English Electric is protesting that Baldwin-Lima may not be qualified as "domestic" under Buy American definition, charging that more than 50% of its proposed work would be farmed out to a Belgian firm.

The Bureau of Reclamation has asked for a 45-day delay in making the Glen Canyon award, until the General Accounting Office can rule on English Electric's protest.

The use of foreign "sourcing"—subcontracting of work to foreign firms—has been publicized in recent months as a possible answer to many domestic producers' difficulties in meeting the increasing competition from foreign bidders. If English Electric's protest is successful, however, the net effect will be to cut back some on such foreign subcontracting.

The present controversy turns almost entirely on how costs are to be defined—foreign or domestic—in deciding which side of the 50% Buy American criteria bidder is on.

Baldwin-Lima-Hamilton admits that 42.7% of its proposed work on the Glen Canyon turbines would be supplied by Societe Anonyme Cockerillougree Seraing, near Liege, Belgium. Under the Act, a firm may qualify as "domestic" as long as at least 50% of its work is performed in the U. S.; and B-L-H claims it has met this criteria. It would supply 39% of its work from its own plant at Eddystone, Pa., and another 18.3% would be supplied by Chicago Bridge & Iron Works at Greenville, Pa.,—total of 57.3% in the U. S.

Seven Manufacturers Bid

In the bidding, opened in early December, seven firms offered to build the eight 155,550-hp, 150-rpm vertical-shaft hydro turbines. English Electric was low bidder ($6,214,552), but Baldwin-Lima-Hamilton was in position to win the award because its second-lowest bid ($6,392,000) would become lowest when the 6% Buy American price differential—$372,824—was added to English Electric's bid.

Five other bidders competed for the job: Nichimen, Japan ($6,584,-560), Allis-Chalmers ($6,795,000), Newport News Shipbuilding & Dry Dock Co ($7,147,000), Dominion Engineering, Canada ($7,691,000), Vevey Engineering Co, Switzerland ($9,600,000).

The Bureau of Reclamation—who will award the contract eventually—has drawn up its own specifications and accounting procedures for determining Buy American qualification. The Bureau follows the basic, but general wording of the Buy American Act and an Executive Order of December, 1954. This calls for deducting from the total bid price certain items before the foreign and domestic work is weighed. These deductions are: (1) transportation costs of any products, foreign or domestic; to the installation site from the bidder's U. S. plant, (2) final assembly or processing costs at the bidder's U. S. plant of either foreign or domestic products; (3) testing costs at U. S. plants and at the installation site: (4) direct profits, overhead and commissions of the bidder, exclusive of similar foreign costs; (5) installation costs at site.

These deductions—which serve to reduce the domestic costs vs foreign buying—are the target at which English Electric's protest is aimed. Baldwin-Lima-Hamilton claims these deductions should total only $620,000 in its bid (leaving $3,306,519 for domestic and $2,-464,881 for foreign work). English Electric claims that the B-L-H deductions should run at least $1,560,-000. Baldwin-Lima, questioned by Electrical World, refused to give a breakdown of the $620,000 figure. A B-L-H spokesman pointed out that such a breakdown was not required in the bidding, however, the company had informed the Bureau

of Reclamation of the elements that make up the figure.

Dominion Engineering's bid included a deduction of $1,200,400 from its total bid price.

The whole issue is now in the hands of the General Accounting Office, where English Electric filed its protest in early January. Actually, the foreign company first complained to the Bureau of Reclamation's district office in Denver in December, shortly after the bids were opened—and it appeared that Baldwin-Lima-Hamilton would win the award. Attorneys in the Denver office reviewed the protest and sent it to Washington for a decision.

In Washington Baldwin-Lima officials were called to explain how the firm had accounted for its foreign and domestic percentages. At this point, English Electric filed the second letter of protest with Comptroller General Joseph Campbell.

No award has ever been mentioned by the Reclamation Bureau, although it is reported that the Bureau was satisfied with Baldwin-Lima's explanation.

The GAO opinion may go beyond a ruling on the specific controversy between two manufacturers. It may set down views relating to all similar bidding procedures.

The ruling will have an impact on all similar future cases—mostly directly on bids, due this month for work at Flaming Gorge Dam in Utah.

REA Power Sales Boosted 15.5% in 1959

Rural electric systems financed by the Rural Electrification Administration sold 25.3-billion kwhr in 1959, up 15.5% over their sales in 1958. The increase came from the greater use of power by consumers and the demand of 139,000 consumers added to rural lines during 1959, according to an REA report issued last week.

"The rise in the number of rural consumers and the demand for more electric power by those already on the lines are signs of the many changes taking place in rural America," said REA Administrator David Hamil in the report. "More and more farmers are using electricity to handle farm chores automatically. Rural business and suburban developments are on the increase, too," Hamil continued. He also pointed out, "Five out of six consumers added to REA lines in the continental U.S. during 1959 were non-farm consumers."

The financial condition of the REA borrowers is healthier too. Net worth of electric borrowers as the year ended was $602 million, or 18.2% of total assets. At the end of 1958, net worth stood at 16.6% of total assets.

During the year, REA approved $279.3 million worth of electric and telephone loans. Other highlights of the report:

• Electric loans during 1959 totaled $171.9 million, bringing the cumulative total of loans made during the past 24.5 years of the program to $4.011 billion. Funds advanced to the systems climbed to $3.474 billion. REA now has 987 active borrowers.

• Purposes of loans — About 71.1% will finance system improvements and new distribution. An estimated 27.4% will go for new generation and transmission facilities. The remaining 1.5% will be used to finance consumer facilities. Through the end of 1959, REA had approved about $911 million worth of G&T loans, accounting for 2,244 Mw of generating capacity and 1,496,000 miles of transmission lines.

• Borrowers generated 4.9-billion kwhr, an increase of 41.7% over '58. Excluding sales between borrowers, they bought 24.2-billion kwhr, surpassing 1958 by 12.6%.

• Revenue per kwhr—Average price per kwhr was 2.36¢ in '59, down from 2.48¢ in 1958.

• Operating revenues rose 9.8% in 1959, totaling about $618.3 million. Net margins totaled an estimated $87.7 million, up 16.6% over '58, after expenses, depreciation and interest were deducted.

• Repayments in 1959 came to $145 million, including payments on principal, interest due and $15.2 million in advance payments. Only one borrower was delinquent in payments, amounting to $97,579.

Mild Winter

Systems are becoming more temperature - sensitive, 90 utilities report. Steel strike effect lingers in some areas

Utility winter peak loads hung slightly below estimates in the pre-Christmas peak-load period of 1959. Mild weather prevailed in most parts of the nation, and side effects of the recently-settled steel strike also served to cut peaks. Variations were generally not far from estimated figures, however.

Temperature continues to exercise more force on system peaks for companies throughout the country. Seventeen utilities reported that mild weather had held peaks below expected levels, while two found that extremely overcast days boosted peaks above estimates. No temperature extremes were reported in the survey.

90 Utilities Surveyed

This round-up of winter peak data is based on an informal Electrical World survey of 90 Class I utilities which reported non-coincident peaks totalling 93,233,800 kw. This peak represents an increase of 4,738,400 kw, or 0.5% above the corresponding previous winter peak. The total peak figure was about 98.9% of the sum of individual peak load estimates.

Over half of the companies reported peaks occurring during Christmas week, the historically-favored period. Monday, December 21, was the date reported most frequently, with December 22 close behind.

A number of peaks did not occur in December, however. The northwestern systems of Puget Sound Power & Light Co, Washington Water Power Co, and Portland General Electric Co peaked on November 16. Six other companies had late October or November peaks.

At least twelve utilities expect peaks later in the winter which will top those recorded to date. This represents the largest group to make such predictions since the introduction of the survey.

Weather Shaves Utility Peak Loads

Business conditions were generally favorable, except for those areas hurt by side effects of the steel strike. Baltimore Gas & Electric Co, Delaware Power & Light Co, Pennsylvania Power & Light Co, Utah Power & Light Co and Western Massachusetts Electric Co all noted loads down because of the steel shortage. However, Duquesne Light Co and West Penn Electric System, both supplying large steel loads, found loads higher than anticipated because of the high level of steel production during the Taft-Hartley injunction period in December.

Summer Peaking Trend Continues

Although the trend continues toward summer peaking, 59% of the companies felt that they were still winter peaking systems. Generally, northern companies serving large metropolitan areas have faced the most rapid transition. Consolidated Edison Co is already a summer peak utility, and Commonwealth Edison Co is still in a transition period. Philadelphia Electric Co and Public Service Electric & Gas Co will be making future forecasts in anticipation of summer peaks.

The American Electric Power System, however, does not expect summer peaks in the immediate future. The AEP load includes electric heating in 19,600 homes and many commercial buildings.

The only report of labor difficulties came from Arizona Public Service Co and Utah Power & Light Co, who listed strikes in the copper industry as holding down peaks. Irrigation loads also dropped on the Arizona Public Service system because of the weather conditions.

Geographically, most companies in the Northeast and Middle West do not expect that their pre-Christmas peaks will be exceeded. Most Pacific Coast companies and many in the South estimate that peaks will be established in the January-March period. This reflects the greater dependence upon winter temperatures of loads in these regions, although this trend is also spreading.

Company	1959 Winter Peak Load Kw	Increase Over 1958–59 Winter Peak Kw	Increase Over 1958–59 Winter Peak %	% Over Predicted Winter Peak	% Over 1959 Summer Peak
Alabama Power Co	1,549,800	46,100	3.1	− 6.1	− 9.5
American Electric Power System	4,730,000	399,000	9.2	− 1.4	10.4
Arizona Public Service Co	355,000	700	0.2	−11.0	−41.4
Arkansas Power & Light Co	671,000	−22,000	−3.2	0.0	−32.1
Atlantic City Electric Co	295,600	17,000	6.1	− 4.0	−11.0
Baltimore Gas & Electric Co	1,023,000	62,000	6.4	− 6.6	− 5.0
Boston Edison Co	969,800	54,300	5.9	− 2.3	12.0
California Electric Power Co	300,400	8,000	2.7	− 0.8	−13.8
Carolina Power & Light Co	1,146,000	98,000	9.4	− 2.1	− 1.0
Central Hudson Gas & Electric Corp	228,300	14,900	7.0	− 0.8	6.2
Central Maine Power Co	391,700	10,500	2.8	− 2.1	7.9
Central Vermont Public Service Corp	115,200	4,900	4.4	− 1.2	5.8
Cleveland Electric Illuminating Co	1,444,000	104,000	7.8	2.0	1.5
Commonwealth Edison Co	4,298,000	365,000	9.3	2.6	3.0
Connecticut Light & Power Co	802,100	45,300	6.0	− 0.9	14.1
Consolidated Edison Co	3,629,000	112,000	3.2	0.1	−12.6
Consumers Power Co	1,795,000	47,000	2.7	− 5.0	8.6
Delaware Power & Light Co	383,800	19,300	5.3	− 1.6	−10.0
Detroit Edison Co	2,734,000	131,000	5.0	− 2.0	5.8
Duke Power Co	2,473,600	143,800	6.2	0.1	0.3
Duquesne Light Co	1,188,100	86,200	7.8	3.3	4.5
EEI & OVEC	2,950,000	.....	0.0	0.0	0.0
Florida Power Corp	632,000	31,000	5.2	− 5.0	20.7
Florida Power & Light Co	1,354,000	100,000	8.0	− 9.4	6.5
General Public Utilities	2,067,000	143,300	7.4	0.2	9.7
Georgia Power Co	2,083,500	115,500	9.5	0.2	−10.6
Hartford Electric Light Co	355,600	14,400	4.2	− 2.7	12.0
Houston Lighting & Power Co	1,205,900	119,600	11.0	− 1.2	−28.4
Idaho Power Co	489,000	34,000	7.5	− 3.4	−15.7
Indianapolis Power & Light Co	527,000	16,000	3.1	− 1.7	− 9.4
Iowa Power & Light Co	270,300	15,400	6.0	− 0.3	− 8.9
Kansas City Power & Light Co	538,100	37,700	7.5	− 2.2	−20.3
Kansas Gas & Electric Co	384,900	22,400	6.2	− 1.1	−24.4
Long Island Lighting Co	950,200	38,100	4.2	− 5.5	14.7
Los Angeles Dept of Water & Power	1,530,000	95,000	6.6	− 1.9	9.8
Louisiana Power & Light Co	369,000	12,000	3.4	− 0.8	−23.1
Mississippi Power Co	256,600	58,900	29.8	13.5	−10.6
Mississippi Power & Light Co	354,000	43,000	13.8	5.7	−18.2
New England Electric System	1,438,000	78,000	5.7	2.2	19.0
New Orleans Public Service Co	243,000	23,000	10.4	5.7	−36.0
N Y State Electric & Gas Corp	794,900	19,000	2.4	− 0.1	14.7
Niagara Mohawk Power Corp	2,945,000	111,000	3.9	− 3.0	14.2
Northern States Power Co	1,366,000	83,000	6.5	− 1.4	6.9
Ohio Edison System	1,676,600	121,000	7.8	− 2.0	8.4
Oklahoma Gas & Electric Co	535,900	20,600	4.0	− 3.6	−32.2
Pacific Gas & Electric Co	4,545,300	432,400	10.5	7.4	− 0.4
Pacific Power & Light Co	996,700	49,200	5.2	− 0.2	27.5
Pennsylvania Power & Light Co	1,374,000	69,000	5.3	− 1.2	3.8
Philadelphia Electric Co	2,448,000	142,000	6.1	− 2.5	− 3.6
Portland General Electric Co	907,000	62,000	7.3	5.6	36.9
Potomac Electric Power Co	871,000	49,000	6.0	0.7	−24.6
Public Service Co of Colorado	644,200	51,500	8.7	0.0	21.4
Public Service Co of N H	307,300	11,400	3.8	− 1.8	6.8
Public Service Co of N M	180,000	34,200	23.5	7.6	9.8
Public Service Electric & Gas Co	2,520,000	171,000	7.3	− 2.0	− 3.0
Puget Sound Power & Light Co	653,200	26,500	4.2	− 2.7	34.2
Seattle City Dept of Lighting	865,000	44,000	5.4	− 7.2	36.6
South Carolina Electric & Gas Co	535,000	28,000	5.5	1.1	− 7.3
Southern California Edison Co	3,181,000	219,000	7.4	0.0	7.5
Southwestern Public Service Co	582,600	38,100	7.0	− 2.7	−20.2
Tennessee Valley Authority	9,301,000	−401,000	−4.1	− 3.9	18.4
Union Electric Co	1,483,000	127,000	9.4	− 0.7	−14.3
Utah Power & Light Co	629,300	71,900	12.9	− 6.1	3.5
Virginia Electric & Power Co	1,554,000	126,000	8.8	− 1.6	− 3.9
Washington Water Power Co	607,000	5,000	0.8	− 4.1	26.5
West Penn Electric System	1,792,000	215,000	13.7	1.8	12.0
Western Massachusetts Electric Co	260,700	−600	−0.2	− 6.9	4.4
Wisconsin Electric Power Co	1,156,600	68,800	6.3	1.4	5.7
	93,233,800	4,738,400	0.5	− 1.1	.....

'PIONEER,' a $2,000 Nik-L-Silver Battery Co car, to go into production in 90 days

'PBX' MODEL undergoing tests by Post Office Department is Cleveland Vehicle product. Range will be about 75 mile with multi-stop operation

1960 Shapes Up as Key Year for

Promising truck potential and sustained interest in small car indicate measurable progress is in store this year. Production plans are firming up; batteries and controls improve

By the end of this year electric utilities should have a clear idea of whether or not electric cars and trucks will be back to stay. Judging from developments of the past few months, it is likely that 1960 will be regarded as the year the renaissance actually got under way.

The basis for this view is the development work now taking place. Four firms are actively interested in developing electric trucks; one of these is in production. Ten development projects for electric cars include production plans by five firms.

Combined with this momentum are the improvements in controls and batteries which promise to gradually broaden the vehicles' short range and increase their speeds.

Here's the status of electric vehicle work in the U. S.:

• Cleveland Vehicle Co has four truck models in production, sold about 25 trucks last year, has a backlog of 115, and estimates 1960 production at 800 units. It is contemplating eight more models.

Two production models are designed for bakery or milk delivery and are similar except in weight and payload. The smaller truck weighs 3,000 lb plus a battery of optional size, but one usually around 2,200 lb. Payload is 3,000 lb.

The larger unit weighs 3,600 lb and has a 3,200-lb payload. Using an 8-hp or 12-hp specially designed series motor, the trucks can accelerate to their 30-mph max speed in 30 sec. They use a five-step conventional controller with no provision for regeneration. Depending on the battery, maximum range is up to 50 miles. In multi-stop service with decreasing payload, however, up to an 80-mile range is possible at a 15-mph average, the company claims.

The trucks cost about $4,500, which includes a $2,200 battery of the buyer's choice. The battery and charger can be leased rather than bought.

Post Office Tests 'PBX'

Two smaller truck models are said to have a 75-mile range. The "PBX"—designed for post office use—has undergone more than six months of tests by the PO Department, which is "very well satisfied" with the model, CV Pres Walter Thomas says.

As for car plans, Thomas reports production begins this year on a 1,600-lb model costing about $1,700 to $1,800. Speeds of 40-45 mph and ranges of 80-100 miles are expected, he says.

• Electric Truck Co of America plans to be producing a delivery panel truck this summer. The chassis and body will be an International Harvester Metro Light. Total curb weight will be 5,500 lb with a 1,100-lb nickel-iron-alkaline battery. With a 1,200-lb max payload, a 40-mile range is predicted at up to 21 mph on multi-stop operation. Motor will be 10-15 hp using magnetic relay step controls. A prototype has been under test by the company, which is headed by John Zappa.

• Traction Service & Engineering Co, a recently formed consulting firm of Rockville Centre, N. Y., is designing a golf cart that is adaptable to light delivery service for a North Carolina firm.

• Willys Motor Co is understood to be working with an electric conversion of the Jeep.

• Cushman Co of Lincoln, Neb., is looking into a tricycle delivery truck. The firm now makes motor scooters.

In the field of electric cars, Atlantic City Electric Co has been running tests on the car delivered by the now-stalled Stinson Aircraft Tool & Engineering Co. This two-door coupe came with two 3.2-hp motors and a four-step pilot con-

'NUKLEA STARLITE' prototype indicates 50-mile range and top speed of 40 mph is feasible. GE assisted in design work

'LEKTRO CAR' may be converted to 695-lb commuter vehicle by Willamette Aircraft. Model can go 40 miles

Renaissance of the Electric Vehicle

troller with magnetic relays. After making many changes, ACE has achieved 51 miles before battery exhaustion at an average of 18.5 mph. This rigidly controlled test used 3.4 kwhr of line power, or 15 miles per line kwhr. For average conditions, however, ACE estimates about 2 miles per line kwhr can be expected. This would give a fuel cost of 1¢ per mile on a 2¢-per-kwhr rate.

The disappointment in Stinson's failure to fulfill its car orders may be tempered by these developments by other prospective car makers:

• The Eureka Williams Corp is stepping into the field by bringing five Renault Dauphine models to the U. S., minus gas-engine components and adapted for electrical gear. An 82-v Exide battery weighing some 600 lb and an advanced static controller will go into each car before delivery about March. Prices for the "pre-production" models are about $3,500. These will include the first 100 cars or so, sold exclusively to utilities for test purposes. The models will have modified Dauphine frames and bodies assembled in Canastota, N. Y.

• In Bluefield, W. Va., the Kersey Co has been building battery-driven coal mine equipment for 12 years. Now it plans to produce a car weighing about 1,300, lb including battery, for some $2,500. Experience and data have been gained in seven-month's of tests on a converted Henry J and a more recent conversion of a Fiat 600. The new fiberglass models will be designed for 70 mile range with a top speed of around 45 mph.

• Nic-L-Silver Battery Co, located in Santa Ana, Calif., hopes to start production in about three months. Early last year, the company announced it would be making deliveries of a $2,000 car by July 1959. The early reports said objectives included a 1,300-1,800-lb weight, a 43-mph max cruising speed, 58-mph max passing speed, 75-mile range, and a battery delivering 365 amp.

This article is excerpted from a one-hour talk before the Jan. 11 Philadelphia Section, AIEE, by C. F. Hochgesang, editor, Electrical World. A limited number of copies is available. Write: Electric Vehicle, Electrical World, 330 W. 42nd St., New York 36, N. Y.

• In Lansing, Mich., Nu-Way Industries has had some design assistance from General Electric Co in putting together two prototype models which indicate a 50-mile range and top speed of 40 mph is feasible.

In addition to these projects, firms such as American Motors Co, Yardney Electric Co and Sunbeam Appliance Co indicate an interest in the field. Smaller companies also are in planning and design stages.

Willamette Aircraft Co of Astoria, Ore., for example, plans to convert its Lektro Car golf cart to commuter use. Several models of the car have been used by Seattle police on parking meter patrols.

Although present batteries cannot give capacity and weight for long-range operation, the industrial types have come a long way. Today a 7-yr life expectancy is possible.

Two approaches in motor control have novel features. One employs a rotating device like a dc machine, with two sets of brushes, one linked to the foot pedal. The pedal position determines the angular distance between the brush-set axes. This unit is used with a shunt motor and permits regenerative braking.

The other method is a pulse-time control. A controlled silicon rectifier passes current when initially "gated" by a special control circuit. A capacitor reduces the rectifier's voltage when the capacitor is sufficiently charged. Since the gate-control device can be set to generate pulses with controllable frequency, the result is that battery voltage is applied to the motor in a series of square wave pulses of constant width but varying rates.

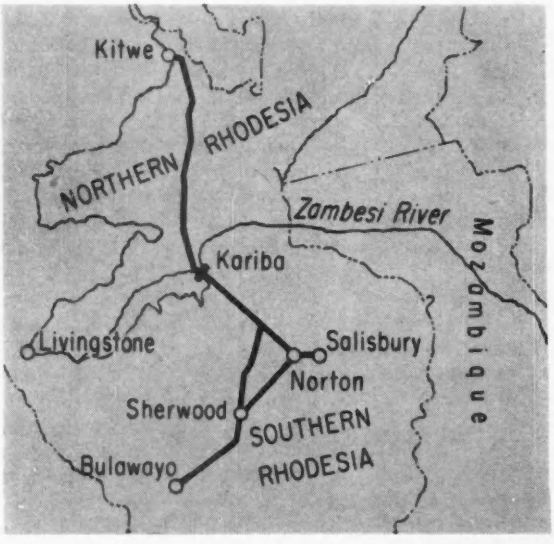
330-Kv Kariba Grid Energized

Single-circuit construction and waisted towers with double ground wires used to minimize high lightning incidence at 5,000-ft altitude

The 887-mile long transmission line system for the Kariba Dam in Africa went into service late last month. With the dam powerhouse as the center of the 330-kv grid, one circuit stretches northward 267 miles to Kitwe, where there is a tie with the Belgian Congo, while two other circuits reach to the south, one going 183 miles to Salisbury and the other 327 miles to Bulawayo. In addition, there is an 87-mile link between the Salisbury leg and the Bulawayo feed.

Economic and technical surveys of probable transmission capacity for the next 20 years led to use of 330 kv as the best compromise between surplus capacity in the early stages and inadequate capacity later. Merz & McLellan of London served as consultants to the transmission project, as well as to the mechanical and electrical aspects of the power station.

The greater part of the line operates at about 5,000 ft above sea level. Consequently, insulation suitable for 380-kv operation at sea level was utilized. Basic impulse insulation level is 1,350 kv. A high-level of lightning incidence dictated the choice of single-circuit construction, employing steel lattice towers 115 ft high, with extensions where necessary. Towers are waisted type with twin peaks for the two ground wires.



RHODESIA-NYASALAND Federation is building 887-mile grid; contract price for initial stage is $27,820,000

Continuous counterpoise is also laid where footing and tower resistance is over 20 ohms.

Phase-to-phase clearance is 37 ft 5 in. and there is a 10-ft min. live metal clearance; min. ground clearance at 150F is 25 ft. A standard 1,500-ft span length is used and all strain towers are designed to withstand the breakage of the two conductors on any one phase, plus one ground conductor. Twin conductors for each phase were considered necessary to reduce corona loss.

Although Kariba supplies a major copper producing region, steel-cored aluminum conductors were chosen for the line. The conductors have an equivalent copper section of 0.35 sq in. and comprise 54/0.118 aluminum strands over 7/0.118 steel strands. A total of 5,600 miles of conductor was supplied by British Insulated Callender's Cables Ltd, Aluminum Wire & Cable Co Ltd, and Richard Johnson & Nephew Ltd.

Insulators, also made in Britain by Pilkington Bros Ltd, are mainly of toughened glass. A single string of 19 discs, 10 in. in dia and spaced at 5.75 in. centers, is used for the suspension sets. Eighteen 11-in. units are employed for the tension sets. The 19-unit strings have 1-minute wet-withstand value of 600 kv at the Kariba altitude.

Additional Substations Planned

The map below depicts substation points at the region's communities. Another substation is being provided at Lusaka, some 85 miles northwest of the dam, and three other tapping points are under consideration.

The 330-kv switchgear at the main Kariba substation and at the other points is of the bulk-oil lenticular tank type. A total of 25 of these circuit breakers, each with 7,500-Mva rating on 3-pole reclosing duty, were supplied by Thomson-Houston Co Ltd. The breakers are designed to give over-voltages of less than 600 kv during switching and reactive loading of transformers. They are made up of six breaks on each phase, and each break is shunted by a linear-type resistor. Pneumatic operating mechanisms are used.

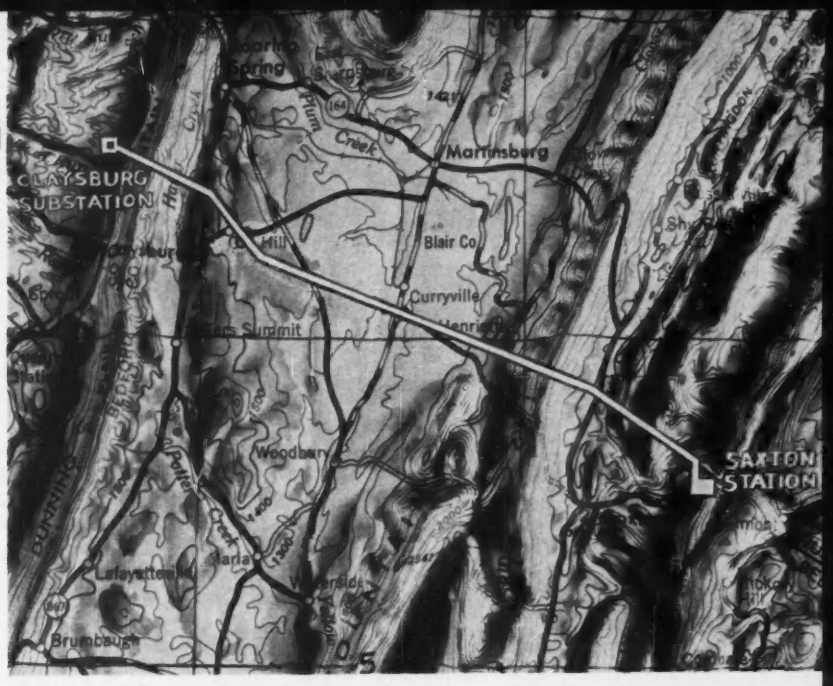
The main Kariba substation is of the duplicate busbar type, and stranded single aluminum conductors are used for the connections. Lightning protection for the substations is provided for by masts constructed above the structures—200 ft high at Kariba and 65 ft above the 72.5 ft height of the other substations.

The 330-kv generator step-up transformers at the powerhouse are single phase 80-Mva units made by English Electric Co. Transport limitations dictated use of single-phase at Kariba, but at most of the other substations, where smaller units are installed, 3-phase 330-kv transformers of 60 Mva are operating. These were manufactured by Ferranti Ltd. At Kitwe, 120-Mva auto-transformers with separate booster transformers were supplied.

All the overhead lines except the Norton-Salisbury route are protected by three-zone, high-speed distance protection. Mho-type relays are used, and superimposed high-frequency carrier current channels use the lines themselves to provide accelerated tripping for distant faults. Main control of the system is carried out from the central control room at Sherwood, using superimposed power line carrier channels and frequency-modulated voice frequency telegraph equipment.

Pennsylvania EHV Line To Carry Full 460 Kv

Penelec 3-phase experimental EHV line will start as part of grid; ultimate project may bring low-cost power east



EHV LINE will connect Saxton Station with Claysburg Substation, 13 miles away, over a mountainous terrain. It will carry load current as part of a functioning 115-kv line and provide data on such operation in severe test circumstances

E. S. KOCSAN, System Electrical Engineer, Pennsylvania Electric Co, Johnstown, Pa.

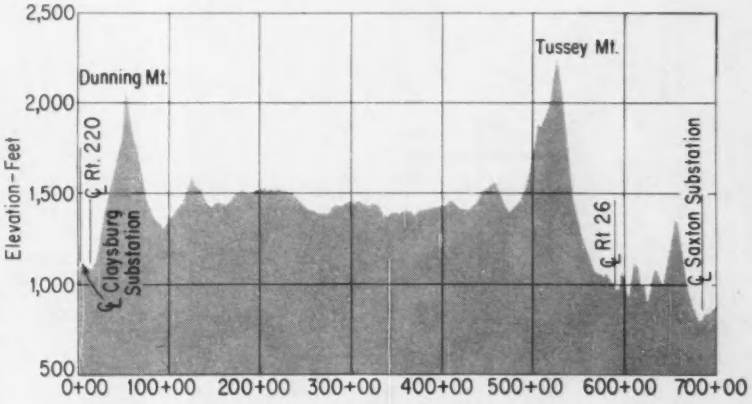
The prototype 460-kv transmission line under construction since December is scheduled by Pennsylvania Electric Co for energization this summer. It will be the first 3-phase 460-kv line in the United States to operate at full voltage and to carry power as part of an established transmission grid.

This experimental line will seek an answer to the growing problem of transmitting larger blocks of power over longer distances and will furnish data on construction costs, performance, and operation of extra-high-voltage (EHV) lines. It will traverse the 13 miles between Saxton and Claysburg in south-central Pennsylvania, on a route about 40 miles southeast of Johnstown.

Penelec, in the heart of that low-cost power generation area, has sister companies of General Public Utilities Corp in eastern Pennsylvania and in New Jersey, where generating costs are higher. Accordingly, all these companies agreed that it would be economically desirable and advantageous to system reliability to add system generating capacity in the Penelec area and to install high-voltage transmission tie lines among the companies.

Planning studies revealed a need for more generation in the western area and for high-voltage lines to bring it east. These findings, along with increasing difficulties in obtaining or in widening rights-of-way for two or more parallel lines, and Penelec's feeling that a move upward from the 230-kv transmission level should allow for maximum future transmission capacities, led to the 460-kv program. The history of EHV trial lines prompted Penelec to design for building its 460-kv line for use, rather than for pure research and development, which the program embraces as coincidental by-products.

The 460-kv line will parallel an established double-circuit steel-tower 115-kv line between Claysburg Substation in Blair County on the west and Saxton Generating Station in Bedford County on the east. It will cross a wide valley and two



460-KV TRANSMISSION LINE, paralleling a 115-kv line, will traverse a wide valley as well as two major mountain ridges which are near both terminals

major mountain ridges, one 1,000 ft above Claysburg, and the other 1,500 ft above Saxton.

The line's route was chosen because of suitable existing terminating substations, a reasonable line length, easy integration into the Penelec transmission system for actual power transmission, and close proximity to the engineering staff headquarters. It also affords desirable test conditions, such as, higher-than-normal lightning frequency and rugged winter weather with wind and icing. The easternmost terminal will be at the GPU nuclear power plant which is expected to be in operation by 1961.

Suppliers Cooperate

Manufacturers and suppliers, seeking to participate in the project, have entered into co-operative agreements with Penelec. They are: General Electric Co's Apparatus and Insulator Divisions; Pennsylvania Transformer Division, McGraw Edison Co; Ohio Brass Co; Aluminum Co of America; Kaiser Aluminum & Chemical Corp; Union Metal Manufacturing Co; Hughes Brothers; Preformed Line Products Co; Bethlehem Steel Co; Rilco Laminated Products, Inc.; I-T-E Circuit Breaker Co; and, Copperweld Steel Co.

Design of the overall line, including basic wood-pole structures and terminal substations, was completed by Penelec's electrical engineering department. The department chose a four-pole structure, engineered with several variations for general use throughout the line. Full-scale destruction tests proved it to be considerably stronger than actual design values.

The basic tangent structure has four poles, 90 to 110 ft high, and X-bracing. Conductors, spaced 24 to 43 ft between phases, will be supported between vee-string insulators. Loadings of the structure are based on a 1,000-ft vertical span and a 1,200-ft horizontal span, with a minimum electrical clearance of 10 ft to any structure member and a ground clearance of 40 ft.

This structure passed full-scale destruction tests on National Electrical Safety Code loading—1½-in. radial ice (vertical load only), 100-mph wind (no ice), and failed only on a transverse loading of 37,500 lb, which is well above the design value.

Many Structures Tested

Original plans for constructing a line wholly of wood-pole structures were modified to allow for the trial and comparison of other structures, such as, full steel towers, guyed metal pole structures, and laminated wood structures. The latter, a minority of the total 93 structures, will be interspersed with the wood-tower structures.

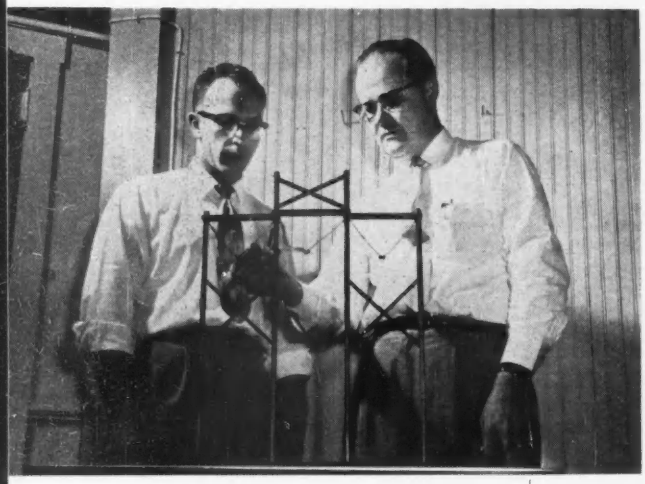
For comparing the corona effects of conductors of various diameters and determining a conductor of an ultimate minimum usable diameter consistent with economy and minimum radio influence effects, the line will be constructed in four parts, each having a different size conductor.

Section A will have about 4 miles of twin-bundled expanded ACSR conductors of 1.75-in. dia, spaced 16 in.; Section B nearly the same length of twin-bundled expanded ACSR of 1.6 in. dia, spaced 16 in.; Section C about the same length of the same type of ACSR of 1.4 in. dia, also spaced 16 in. The remaining 1½ miles will have single conductor of specially designed 2.32-in.-dia ACSR conductor.

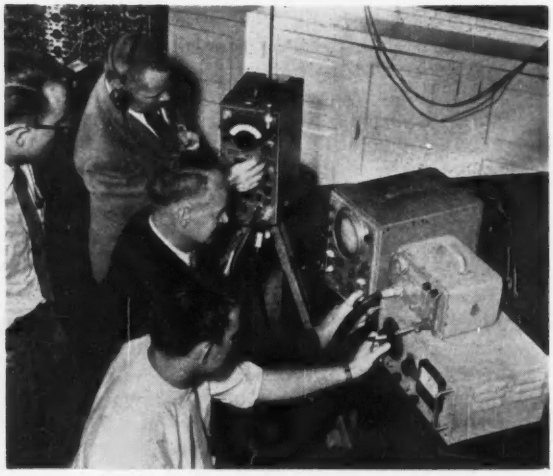
190-Ft R/W Cleared

A 190-ft right-of-way has been cleared for the entire length of the line. The crossing of two mountain ridges has necessitated building several access roads for line construction and accessibility to test equipment.

During an expected two-year test period, lightning and weather will be studied from the higher elevations, and electrical recording and photographic test equipment will be frequently observed. Tension stringing will be employed during construction to prevent conductors being dragged on the ground and thus scarred or deformed. Experience has shown that this procedure has the effect of helping new conductors



PRELIMINARY MODEL of transmission structure is studied by Penelec transmission engineering department members



RADIO INFLUENCE from EHV operation is gauged by engineers, using radio-interference field intensity meter

to retain a high corona threshold voltage.

The line will terminate at each substation in a 1,600-amp motor-operated 460-kv disconnect switch, with a similarly rated accompanying 460-kv ground switch. Specially built power transformers will step down the voltage to 115 kv, and 115-kv oil circuit breakers on the main transformers' low side at each end will perform line switching.

The Claysburg terminal will have a special 3-phase, 50-Mva autotransformer; the Saxton terminal a 60-Mva bank of three specially built single-phase 20-Mva autotransformers. The station-type lightning arresters at both ends will be 378 kv. Conventional carrier coupling capacitors and line traps will be installed at both ends of the line on one phase.

How Line Is Protected

The remaining components of the terminal substations, it is expected, will be conventional in design and application, but their physical dimensions will be commensurate with the 460-kv apparatus.

Primary protection of the line and the two power transformers will be a permissive over-reach transferred trip scheme, using impedance distance and carrier ground relays. The autotransformers will be protected by transformer differential relays with the simultaneous transferred trip of the remote breaker. Operation of the transformer differential relays will trip the OCB's and lock out reclosing at both ends. It can be initiated at either end.

To Parallel 115-Kv Line

It is planned to parallel the double-circuit 115-kv line between Claysburg and Saxton with the completed 460-kv line for certain periods and for purposes of test. There will be times when the 115-kv circuits will be opened, and the 460-kv line will have to carry loads up to the maximum capability of the 460-kv power transformers. It is expected that little, if any, unbalance will exist on any phase of the 460-kv line, so that a time overcurrent relay on one phase, fed from a 115-kv current transformer, will detect an overload condition of the 460-kv transformers. When this occurs, this relay will cause the electric paralleling of the adjacent 115-kv line and subsequent tripping of the 460-kv line.

RIGHT-OF-WAY for new EHV line is 50 ft wider than typical right-of-way for a 230-kv line. Here it descends Tussey Mountain foothills to Saxton Station

Test objectives include affirmation of sufficient insulation levels, ability of the line to carry power as part of an existing system, and observation of the effects of seasonal and abnormal natural and atmospheric conditions. General Electric Co will conduct the program that will study lightning in the vicinity of the line and its effects upon the line. An independent study of switching surges is expected to involve the instrumentation of the lightning study.

Corona Study Set

A study of corona, its effects, and measurement will attempt to evaluate the comparative corona thresholds and levels among the four conductor sizes and various configurations. Anticipating these studies, Penelec is already measuring and recording noise levels on 115 and 230-kv lines and expects that the results to provide standards for similar 460-kv tests.

Carrier will be applied to the 460-kv line, using a wide-band capacitor coupler. Tests to determine whether carrier is practical at 460 kv will include a comparison of frequencies within the carrier spectrum, AM vs FM systems for voice, dependability and security of carrier-operated devices, and the effectiveness of wide-band vs narrow-band carrier systems at these voltages.

What Future May Hold

Induced and coupled effects which the high-voltage line may produce on near-by lines of other utilities, or on lower-voltage distribution circuits, will be investigated also.

If the Saxton-Claysburg, 460-kv line is accepted as planned, it could become a section of a proposed west-to-east 460-kv transmission line, bringing power from coal-based stations in Penelec territory to sister GPU companies. Moreover, it could lead the way for Penelec and other utilities in superimposing 460-kv lines over present 230-kv transmission networks when load-carrying demands exceed facilities.

Computers

Individual digital computer control system will supervise operation of two 210-Mw boiler-turbine installations at Southern California Edison steam generating station. Additional cost of $1,200,000 per unit expected to be repaid over life of units through increased availability, lower fuel and maintenance costs

AUTOMATED UNITS AT HUNTINGTON BEACH shown under construction at right, are being added to an existing power station first operated in 1958. Units 1 and 2 are twin 200-Mw cross-compound units with natural-circulation boilers. Automated units No. 3 and 4 are two 210-Mw cross-compound turbines with universal pressure boilers of 1,638,000 lb per hr. Steam conditions are same as for first two units; 2,400 psig, 1,050/1,000 F

W. L. CHADWICK, Vice President, Southern California Edison Co, Los Angeles, Calif.

Today's insistent emphasis on reliability by utility customers, regulatory commissions, and operating companies, coupled with economic need to protect the increasingly large amount of capital tied up in modern steam station units, makes imperative the use of every practical control aid.

To meet these demands, Southern California Edison Co made the decision to build computer-supervised controls into units No. 3 and No. 4 at its new Huntington Beach steam plant.

Benefits expected from use of the computer supervisory system are these:

1. Increased safety for personnel and equipment from major accidents. The probablility of a major accident should be materially reduced under the alert, sentinel service and the precise direction of the supervisory system, especially during start-up and shutdown operations. The cost of one avoidable four-month interruption plus the consequent cost of replacement power during the operating history of a 200-Mw unit is estimated at $3,500,000.

2. Improvement in continuity of service. It is anticipated that the supervisory system will reduce the number of unit outages, because of prompt corrective actions during emergenices. Moreover when outages do occur, faster returns to service will result than is possible under conventional control.

3. Reduction in fuel costs. A saving equivalent to ½% increase in plant efficiency is expected because of continual monitoring of plant performance and because of more precise control from the supervisory system.

4. Reduction in operating costs (manpower). It will be possible to operate the two new units with eight fewer employees than conventionally with a consequent capitalized saving of $738,000. This saving is net after addition of two maintenance men who would not be required with conventional controls.

5. Reduction in maintenace costs. Although there will be some increase in cost of instrument maintenance, a significant overall saving will be realized in maintenance of major operating equipment because of better temperature control.

The estimated aggregate value of tangible savings is $1,116,000, aside from avoidance of a major outage. In view of these savings, the use of computer controls seems as mandatory as the use of relay-controlled circuit breakers to avoid circuit burn-downs.

Today's interest in applying computer techniques to power station controls is similar to that which advanced the development of electrical relays 30 to 40 years ago. Prior to that time a circuit interruption continued until human action cleared the trouble and restored service. Demand that such interruptions be avoided brought development of devices which detect the cause and clear it in a few cycles without human intervention.

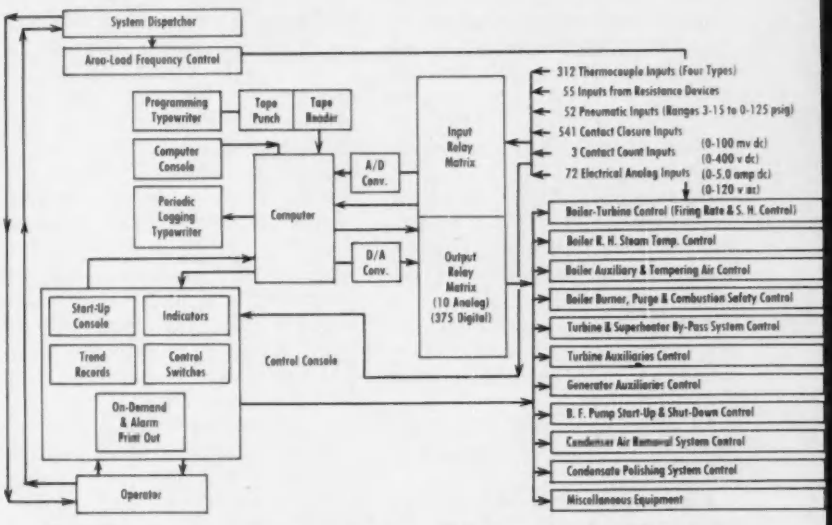
to Automate Huntington Beach Units

An actual count shows that 1,560 informational input and 800 output channels are available for manual attention of one or two operators in the control room for Huntington Beach units No. 1 and No. 2. Obviously, only a small fraction of these could be utilized in any minute of operation regardless of a grave emergency. By means of computer supervised control, it is expected that reliability and availability can be improved and the human operator can be elevated from an operator of individual equipment to supervisor of a control system.

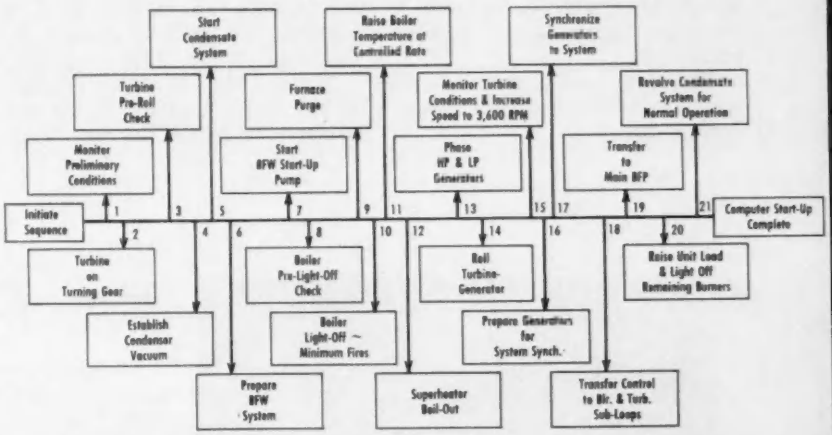
In planning the new installation, consideration was first given to the use of automatic data logging, like that developed for certain process industries, and for one or two other steam electric stations. While such an application would present information somewhat more conveniently than the more conventional methods, it was not clear that reliability of service would improve. Its use would still depend upon human action with some resultant time lag. This kind of application did not seem worth the cost. But it was reasoned that if logging, and the related scanning, could be combined with programmed actuation, a greater operating alertness could be achieved than that conventionally possible. Interruptions could be reduced in number, gravity and duration.

This concept led to a year's intensive study of computer supervised controls by a task force representing both operating and engineering viewpoints. It also included, on a joint cost-sharing basis, engineers from Bechtel Corp. The group enjoyed fine cooperation from manufacturers of not only computers, but also of turbine-generators, boilers, condensers, feed pumps and instruments.

Two concepts were seriously considered for the automation system. One was to make maximum use of normally provided conventional sub-loops and integration of these through computer programs and control. The other was to impose computer control directly without sub-loops. After careful considera-

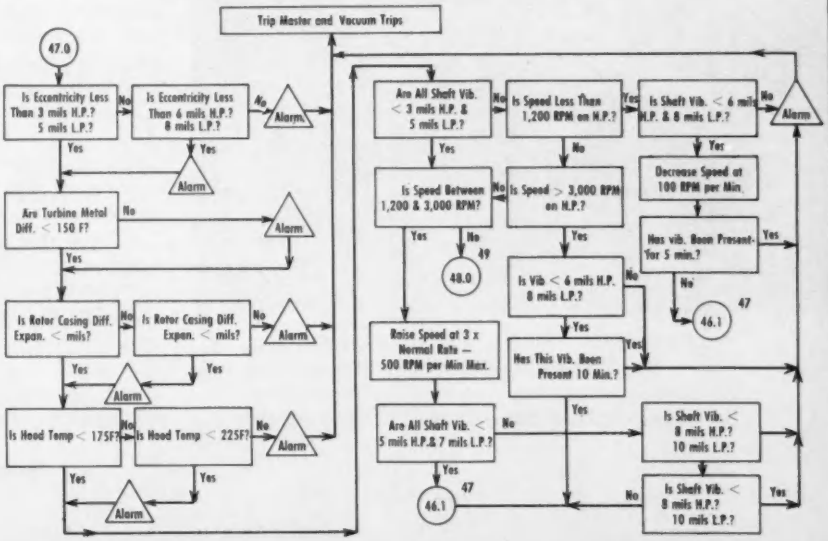


▲ **Automatic Computer Supervisory Control System**


Start Condensate System
Raise Boiler Temperature at Controlled Rate
Synchronize Generators to System
Turbine Pre-Roll Check
Furnace Purge
Monitor Turbine Conditions & Increase Speed to 3,600 RPM
Revolve Condensate System for Normal Operation
Monitor Preliminary Conditions
Start BFW Start-Up Pump
Phase HP & LP Generators
Transfer to Main BFP
Initiate Sequence
Computer Start-Up Complete
Turbine on Turning Gear
Boiler Pre-Light-Off Check
Roll Turbine-Generator
Raise Unit Load & Light Off Remaining Burners
Establish Condensor Vacuum
Boiler Light-Off — Minimum Firing
Prepare Generators for System Synch.
Prepare BFW System
Superheater Boil-Out
Transfer Control to Blr. & Turb. Sub-Loops

▲ **Automatic Start-Up Sequence for Automated Units**

▼ **Excerpt From Automated Start-Up Program**


Trip Master and Vacuum Trips
47.0
Is Eccentricity Less Than 3 mils H.P.? 5 mils L.P.?
Is Eccentricity Less Than 6 mils H.P.? 8 mils L.P.?
Alarm
Are Turbine Metal Diff. < 150 F?
Is Rotor Casing Diff. Expan. < mils?
Is Hood Temp < 175F?
Is Hood Temp < 225F?
Are All Shaft Vib. < 3 mils H.P. & 5 mils L.P.?
Is Speed Less Than 1,200 RPM on H.P.?
Is Shaft Vib. < 6 mils H.P. & 8 mils L.P.?
Is Speed Between 1,200 & 3,000 RPM?
Is Speed > 3,000 RPM on H.P.?
Decrease Speed at 100 RPM per Min.
Has vib. Been Present Yor 5 min.?
48.0
49
Is Vib < 6 mils H.P. 8 mils L.P.?
46.1
47
Raise Speed at 3 x Normal Rate — 500 RPM per Min Max.
Has This Vib. Been Present 10 Min.?
Are All Shaft Vib. < 5 mils H.P.& 7 mils L.P.?
Is Shaft Vib. < 8 mils H.P.? 10 mils L.P.?

tion of both possibilities and the present state of the art, it was concluded that the first would be more prudent because it would allow manual take-over whenever the computer might be out of service.

Complete automation, to the extent that the station might be operated without human attendance, was not considered seriously at this time because of the need for development experience.

By means of digital computers, the automation system will perform the following operating functions conventionally performed by the control room operator:

- **Data logging**—recording specific data and signalling deviant conditions, both by audible alarm and by print-out.
- **Computing** - making programmed calculations from logged data.
- **Automatic supervision**—starting, stopping, and load-changing of major plant equipment and directly-associated auxiliaries, as well as corrective action during abnormal conditions.

The more specific criteria which have governed the extent of automation are these:

1. All operations which are essential to control the start-up, normal operation, and shutdown of the boiler, turbine-generator, and associated auxiliary equipment will be automated. These auxiliaries include all items that would normally be provided with closed-loop protective systems, but that could misoperate and cause an unsafe condition that in turn might result in damage in major equipment or jeoparadize the safety of personnel.

2. All equipment essential to the operation of the boiler, turbine-generator and associated auxiliary equipment as a unit will be automated to the extent necessary for good operating procedure, safety, and optimum economy, but with the long-range objective of complete automation in mind.

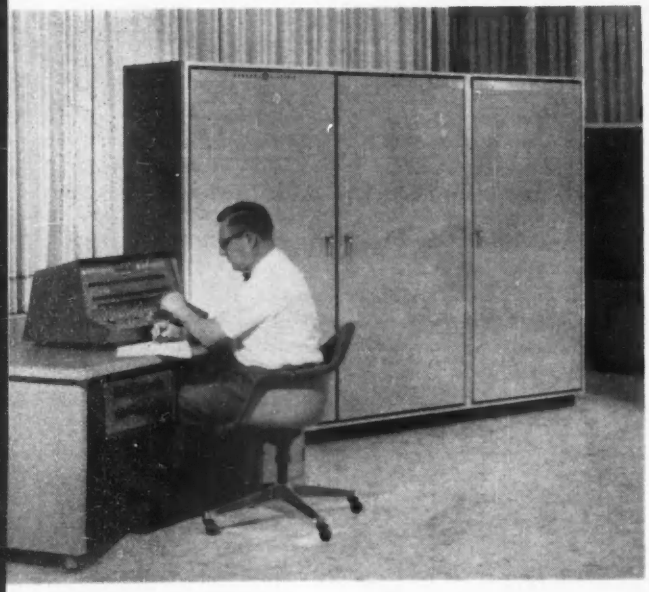
3. All equipment which requires initiation, or adjustment, during start-up, normal operation, or shutdown, and which is not normally provided with sub-loop control for this purpose, will be automated to eliminate the need for manual intervention during these sequences.

Detailed consideration was given to the proper location, in the full operating sequence, of the "start-up pushbutton"; in other words, to the number of preconditioning actions which should be included under the automation system. It was finally decided that during normal cold start-up this key control would be initiated just prior to placing the turbine on turning gear. The reasons follow:

1. Auxiliary equipment which cannot logically be associated with a particular unit, but is common to more than one unit, was excluded from supervisory system control. This equipment is normally in service at all times and is controlled most efficiently by self-contained sub-loops or manually.

2. Operations which are normally preparatory to start-up, and equipment which is not normally affected by start-up, normal operation, or shutdown of a unit, were excluded from automation. All such operations and equipment, however, will be monitored by the supervisory system where it is necessary to provide interlocks that will control initiation of the automatic start-up sequence.

3. Increased cost of extending automation to functions that are not critical.



MODEL 312 COMPUTER CONSOLE contains printed plug board and scanner equipment with related components. Each automated unit has its own individual computer

How Computer Control

The extent to which automation has been applied to the major systems, equipment, and operating functions of the Huntington Beach units No. 3 and 4 is indicated below. In the following discussion the words "supervisory system" are used to designate the computer integrated control system.

1. The circulating water system is essentially a manually-operated system normally placed in operation well in advance of start-up. Once in operation it requires no control other than integral sub-loops which control the supply of water to bearing cooling water heat exchangers and for protection of the condenser. Hence, no automatic control is being provided, but the following points will be continually monitored by the supervisory system for alarm purposes only:

- Pressure drop across the condenser tube sheets.
- Pump motor bearing temperatures.
- Pump bearing water supply.
- Condenser inlet and outlet temperatures.

2. The bearing cooling water system is common to both new units and is normally in service at all times. This common system is protected against low pressure by an integral sub-loop which will start a stand-by pump. Supply valves to individual pieces of equipment

Major Equipment Used for Huntington-Beach Units No. 3 and 4

Boilers—The two Babcock & Wilcox universal pressure boilers each have a maximum continuous rating of 1,638,000 lbs. per hr, at 2,450 psig and 1,050F superheated steam, and 1,339,000 lbs. per hr at 1,000F reheated steam. The pressurized furnace will be divided into two equal sections by a division wall. Each section will contain twelve combination oil and gas burners in the front, rear, and side walls. Automatic burner controls will be provided by Forney Engineering Co. Main steam and reheat steam temperature control will be accomplished by firing rate and by positioning of the flue gas proportioning dampers.

Unit No. 3 Turbine-Generator—General Electric Co 210,000-kw cross-compound 3,600 rpm/1,800 rpm, axial flow. Throttle conditions: 2,400 psig—1,050F/1,000F. Steam extraction for seven stages of feed water heating. Separate first stage nozzle boxes arranged to operate with four steam admission valves.

Unit No. 4 Turbine-Generator—Westinghouse Electric Corp. 210,000 kw cross-compound 3,600 rpm/3,600 rpm, quadruple flow. Throttle conditions: 2,400 psig—1,050F/1,000F. Steam extraction for eight stages of feed water heating. Separate first stage nozzle boxes arranged to operate with eight steam admission valves.

Unit No. 3 Condensers—Ingersoll-Rand 110,000 sq. ft., two-pass, sea water cooling, 7/8-in.—18 BWG aluminum brass tubes with divided water boxes and twin-tray divided hotwell.

Unit No. 4 Condensers — Ingersoll-Rand 105,000 sq. ft., single-pass, sea water cooling, 7/8-in.—18 BWG aluminum brass tubes, with divided water boxes and twin-tray divided hotwell.

Boiler Feed Water Pumps—Pacific Pumps, Inc. One full capacity main pump with each unit for operation through the 3,600 rpm turbine-generator shaft and an hydraulic coupling. A separate one-third capacity, constant speed start-up pump with each unit.

Forced Draft Fans — Buffalo Forge Co. — two half-capacity fans, for variable speed operation by a constant speed motor through hydraulic couplings. Outlet dampers will assist control of air flow.

Computers—Two General Electric computers. General purpose stored-program solid-state digital computers each with 16,000 word magnetic drum memory. Equipment furnished with a computer includes a computer console for operation of the computer; a typewriter, paper-tape punch, and tape reader for program preparation and address of the computer; one logging typewriter and small line printer for displaying the information received from the computer; and the necessary input-output equipment to condition data.

Each computer will continuously scan 900 input points at rates up to 300 points per sec. About 50 critical quantities are logged periodically. Some of these are derived by computation within the computer and others are obtained directly by scanning. The equipment is capable of handling 250 contact outputs and providing 10 analog output signals.

Will Be Applied to Systems and Functions

are normally left open at all times and they will not be monitored or controlled by the supervisory system except where regulating valves are provided for temperature control. The following points will be continually monitored by the supervisory system for alarm only:

- Supply header temperature.
- Supply header pressure.
- Pump and motor bearing temperatures.
- Supply tank high and low level.

3. The compressed air system is common to all units in the station and is, therefore, manually operated and provided with an integral sub-loop to start automatically a stand-by compressor on low pressure. Points to be monitored by the supervisory system for alarm only are:

- Instrument, service, and aspirating air pressures.
- Compressor discharge air temperature.
- Compressor bearing temperature and oil pressure.

4. The 230-kv switchyard, 4,160-v and 480-v unit switchgear, motor control centers, and the 240-v ac, 120-v ac, and 125-v dc electrical distribution systems are considered to be in operation at all times and under manual control. Protection of this equipment is provided as an integral part of each system. It was therefore not considered necessary, or economically feasible, to automate any of their operating functions except control of the circuit breakers and motor starters of equipment under supervisory system control.

Particular points are monitored by the supervisory system for data logging, interlock, or alarm as follows:

- Protective relays ..... alarm
- 230-kv oil circuit breaker ..... indication
- Unit bus voltage ..... log
- 4160-v breaker trip ..... alarm
- 480 v breaker trip ..... alarm
- Generator and auxiliary bus kwhr ..... log
- 4160 v reserve tie breaker ..... interlock
- Dc breaker trip ..... alarm
- Synchronizing relays ..... interlock

5. The condenser vacuum system is being completely automated for control and monitoring by the supervisory system in accordance with the various operating programs. This is because of its function in the start-up sequence and during normal operation, and of its close relation to turbine operation.

6. The generator hydrogen and seal oil system is purchased as an integral unit and provided with its own self-contained sub-loops for control and regulation. It is neither economically feasible, nor desirable from an

operating standpoint, to further automate this system now. Therefore, only the following points will be monitored or controlled by the supervisory system for purposes of alarm, logging, and safety:

- Hydrogen supply valve—MOV controlled and monitored as protection against regulator failure.
- Gas vent valve—MOV controlled and monitored.
- Purity vent MOV controlled and monitored.
- Control panel alarm.
- Gas pressure, gas purity, differential seal oil pressure, water detector, hot and cold gas temperature are monitored for alarm and control.
- Ac and dc supply (interlock to prevent false operation from purity indication).

7. The condensate system will normally be placed in operation well in advance of an automatic start-up sequence because of the requirements for condensate polishing and oxygen removal. Consequently the system will not be completely automated. It will normally be placed in operation manually and will have critical valves, pressures and temperatures monitored by the supervisory system for alarm purposes. System control will be provided, however, to automatically valve the condensate system into a pre-cycle flush during the start-up sequence prior to firing the boiler.

Sub-loop control will be provided for condensate pump minimum flow, deaerator level control, deaerator high level protection, low pressure heater drain system operation, and hotwell level.

8. The polishing demineralizer will be sub-loop controlled for regeneration. Provision is being made for supervisory system control and monitoring during "in service" operation because of its function in the condensate system and because it is to be a common system.

Supervisory system control will be provided for automatic valving to prevent mixing unit 3 and 4 condensates during start of either unit.

9. The feedwater system will not be completely automated. Because of their functions in over-all unit operation, the start-up pump, main boiler feed pump, and the valves required for placing this system in service will be completely controlled and monitored by the supervisory system. Valves which are normally open at all times will not be automated, except for safety.

10. The feedwater heater vents are normally left in open position and will not be automated for control or monitoring purposes. The heater drains are provided with sub-loop controls for equipment protection and will be automatically revalved by the supervisory system for polishing during start-up.

11. The chemical feed pumps will be initiated and monitored by the supervisory system, but controlled by sub-loops, because of their position in the start-up sequence. Supervisory system control will be directed by instrumentation provided for monitoring feedwater.

12. The fuel oil system is common to all units in the station, up to the boiler combustion control valves. Hence, this portion will not be automated. Sub-loop control will regulate the fuel supplied to a boiler.

Fuel oil pressure, flow, and temperature will be monitored by the supervisory system for alarm and logging.

The fuel oil trip valve will be automated to the extent that it is reset by the supervisory system during a start-up sequence. Tripping will be sub-loop controlled.

13. The fuel gas system also is common to all units in the station up to the combustion control valves. Hence, this portion of the system will not be automated. For normal operation, a sub-loop control will be provided for regulating fuel supplied to the boiler. During start-up and shut-down, regulation of fuel flow and burner control will be accomplished by a sub-loop or by the supervisory system in accordance with programmed operating sequences. Since during start-up the shut-off valves ahead of the burner and igniter gas trip valves must be operated, they will be automated.

14. The boiler draft system, consisting of the forced draft fans, air preheaters, and burner air registers, will be essentially an automated system having either sub-loop or supervisory system control and monitoring.

The forced draft fans will be started and stopped, and bearing temperatures will be continually monitored by the supervisory system. The forced draft fan dampers will be controlled by either a sub-loop or by the supervisory system in accordance with a programmed sequence.

The air preheaters will be started and stopped, and bearing temperature and isolation dampers will be monitored by the supervisory system.

The burner air registers will be controlled by either a sub-loop or by the supervisory system, as required.

The flue gas analyzer will be manually started, normally in service at all times and continually monitored by the supervisory system for logging and alarm.

15. The turbine and boiler bypass systems consist of the turbine bypass and superheater bypass control valves and will be operated by sub-loop control systems having overall control by the supervisory system.

The flash tank associated with this system will have temperature and pressure sub-loop control and will be monitored by the supervisory system for alarm.

16. All boiler drains essential to safe operation of the boiler will be automated for control and/or monitoring by the supervisory system. Drains which are not required for in-service operation of the boiler will be manually operated and are not monitored.

17. Main steam temperature will be controlled by the supervisory system for start-up and automatically transferred to a sub-loop control for normal operation.

Reheat steam temperature will be controlled by dampers positioned by supervisory system for start-up and controlled by sub-loop during normal operation.

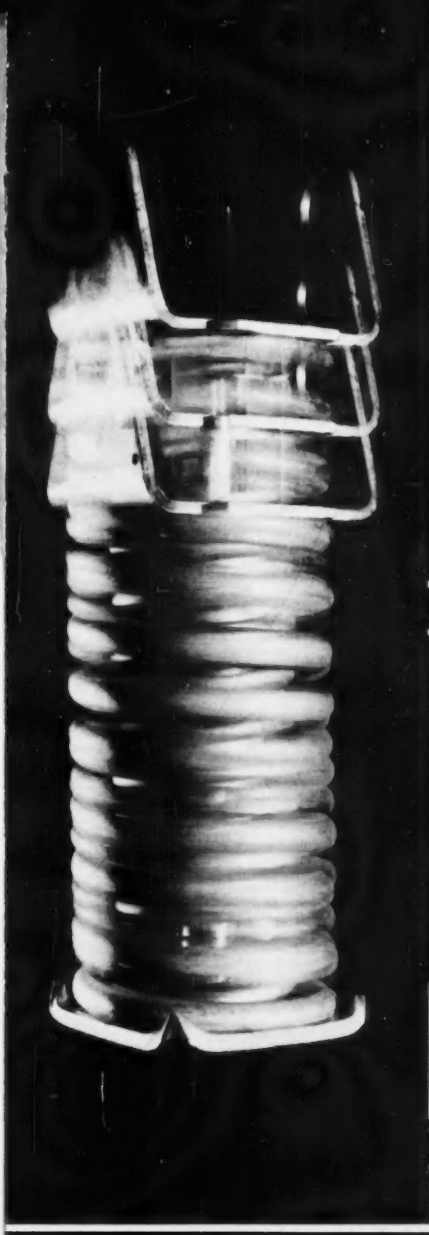
18. Boiler protection will be provided under sub-loop control by the following fuel trips:

- Loss of forced draft fans.
- Low fuel pressure.
- Turbine stop valve closure.
- Low feed water flow.
- Emergency fuel trip button.

19. The turbine-generator will be completely automated and under control of the supervisory system during all programmed operating sequences. Normally provided protective sub-loops are being retained and augmented by supervisory system controls as required.

20. The excitation equipment for each generator will be completely automated as a requirement of automatic start-up and shut-down sequences. Normally provided protective devices are being retained and critical points will be continually monitored by the supervisory system for alarm and control.

(*Continued on page* 59)



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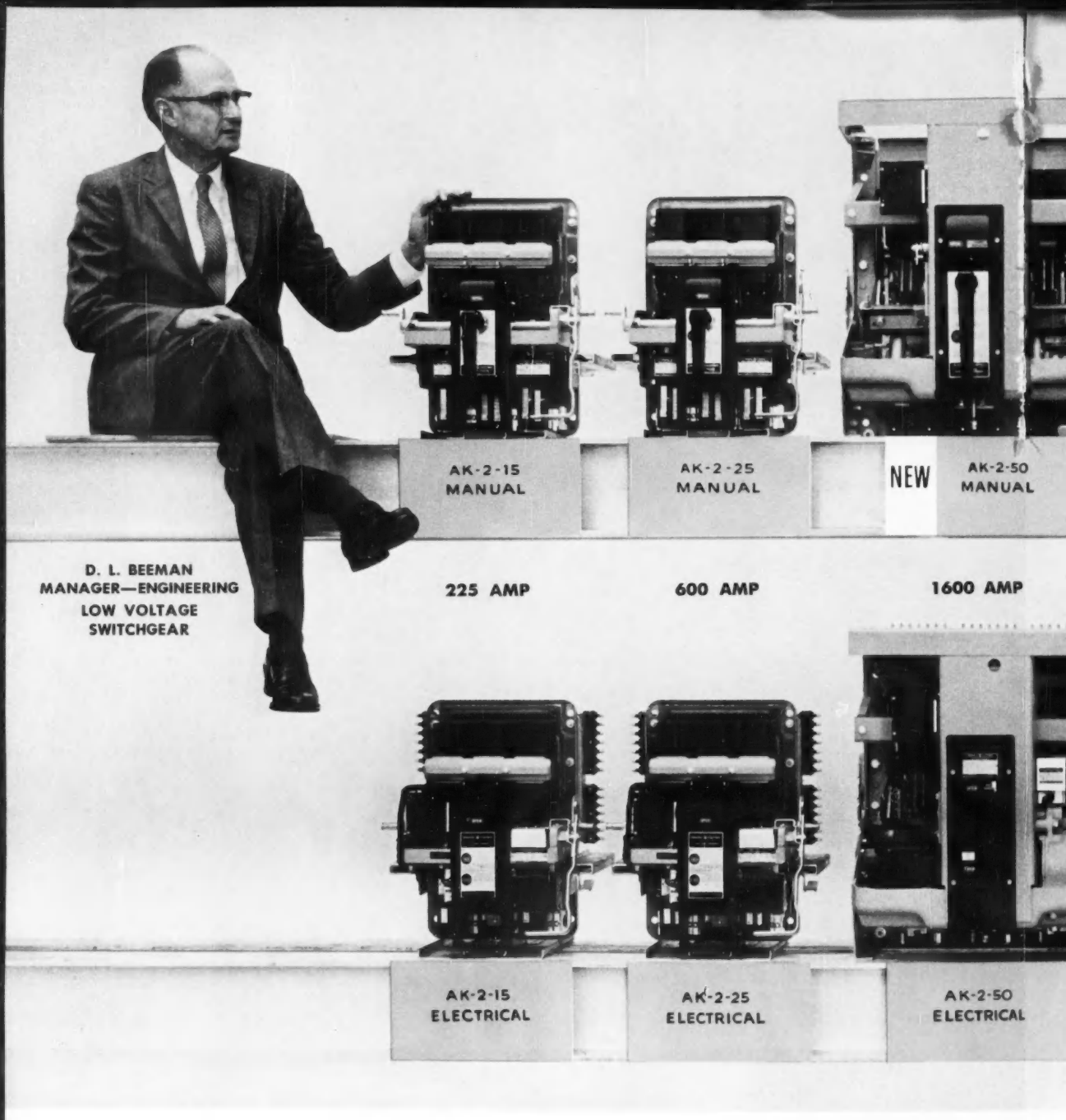

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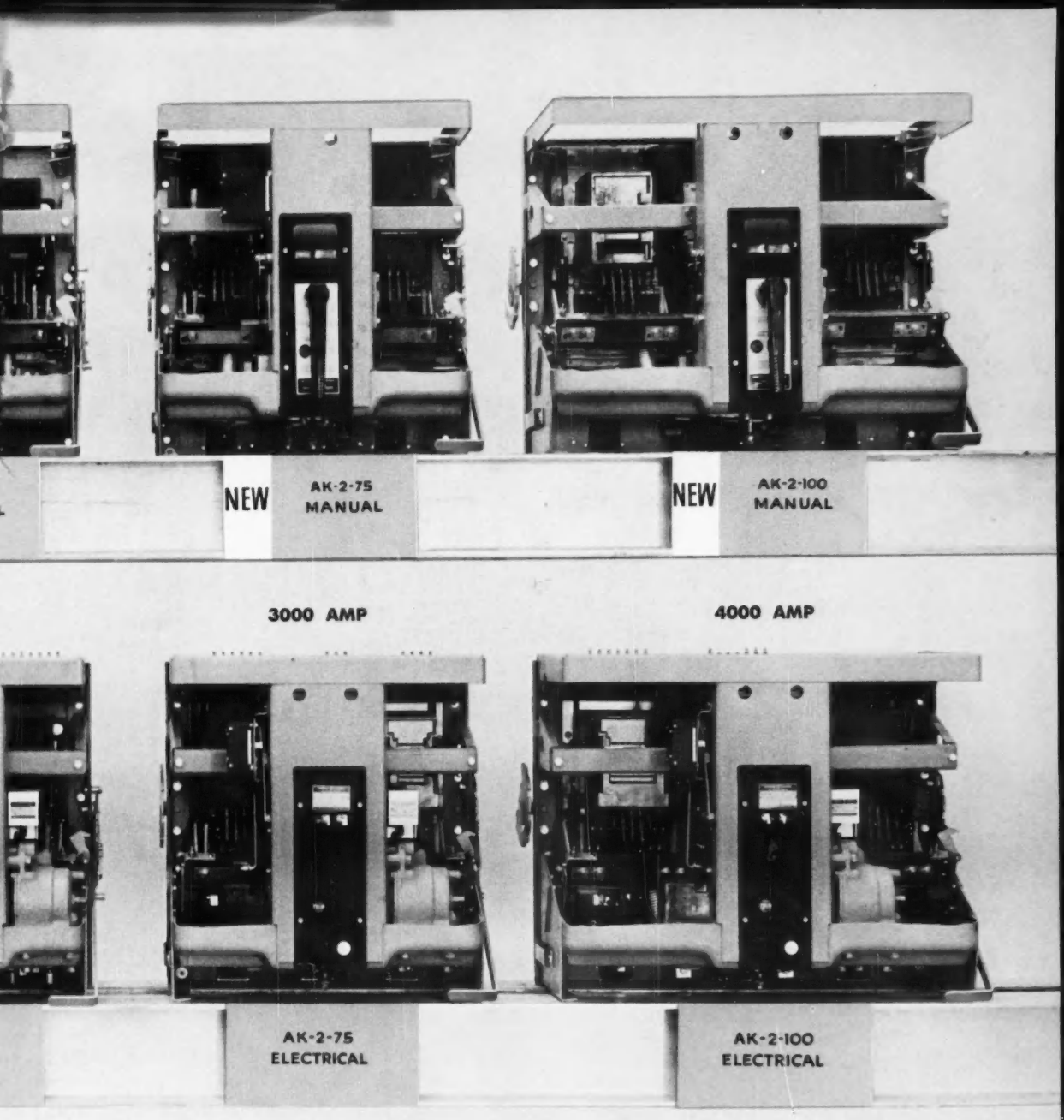

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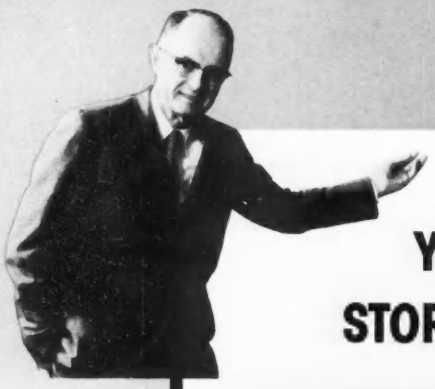

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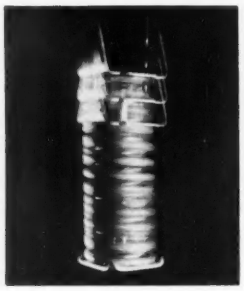

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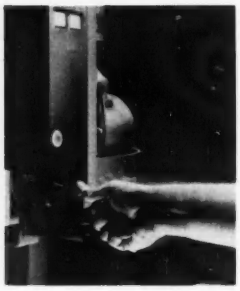

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The stored-energy breaker will last longer, need less attention because it closes with constant force.

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534-1

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Progress Is Our Most Important Product

GENERAL ELECTRIC

Huntington Beach Station (*Continued from page 54*)

Details of Automation Explained in Q and A

How much investment is represented by automatic control for each unit?

The approximate additional capital cost per unit for the automation system as now conceived is $1,180,000. The Company fully expects this cost will be repaid during the life of the related units through better availability, lower maintenance, and lower operating costs.

How many men will be on duty? What do they do?

For two-unit operation, the objective is to have an operating force of two and one-half men per shift, comprising one control operator, one plant equipment operator, and one-half of the watch engineer assigned to four units.

One fundamental concept, used in all Edison stations, will also be pursued in building the new control system. Namely, when instruments and devices are substituted for men, they must be as well "trained" for their tasks as would be the equivalent men. Calibration and testing must be as complete as reasonably possible before operation is undertaken.

Are the two automated units linked in any way?

The only common tie between units No. 3 and 4 will be through the generators being synchronized to the network, and through the network area-load frequency control. Each unit will have its own control computer and will act independently of the other.

How is operation integrated with other units in the station and with other stations on the system?

Integration with the operation of manually-controlled units at the station and with other stations of the system will not be affected by automation. Operation of all units and stations of the Edison system is normally under control of an economic dispatch computer which is a part of Leeds & Northrup Co area load-frequency control equipment.

Under normal conditions unit generation, in megawatts, is totalized into station generation. This signal is then transmitted to a central load proportioner. The station requirement, in megawatts, is received at each station as a signal from the central load proportioner requesting an increase or decrease in station generation. This quantity is reduced at the station to generating unit requirement in the form of "raise" or "lower" impulses to control each unit on a predetermined economical basis.

During periods of system instability, a variation of plus or minus 0.4 cycle in system frequency will cause the area load frequency control equipment to trip off and place each unit under local manual control.

Is the control system capable of completely automatic operation with "hands-off"?

The supervisory system will be capable of complete automatic start-up, including synchronizing and loading of the unit, without operator participation. Upon initiation by the operator it will shut down automatically.

Although synchronizing and loading of the unit are to be automatic, transfer to the system area load frequency control will be delegated to the operator in order to permit proper coordination with the power system dispatcher.

It is expected that the unit will be on the line at ⅓ load in a minimum of 4½ hr time after initiation of the automatic sequence. It is estimated that a manual start would require between 6 and 7 hr.

What key intelligence will initiate automatic action?

The primary signal for the initiation of automatic action will be the operator's "start" pushbutton. Each successive automatic action is dependent upon successful completion of the previous step. After the unit is on the line and operating normally, the majority of control functions and corrective actions will be performed by conventional control sub-loops, with the computer supervising the operation and notifying the operator of any improper functioning. Even on a safety trip of the unit initiated by conventional protective devices, the computer will determine whether the proper operations have been successfully completed. Some corrective action will be initiated by the computer itself, such as reduction of load in case of generator high temperature and introduction of tempering air into the boiler furnace when boiler tube temperature is too high.

In event of deviation from expected operation how does the control system call for help?

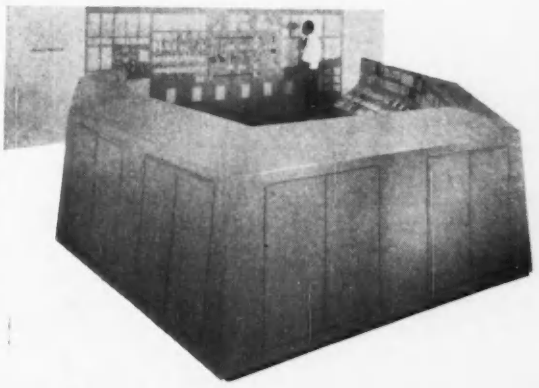
Should the supervisory system fail to maintain proper control, it will signal to the operator via the alarm printer. The operator must still exercise judgment as to when he takes control from the computer.

One important design criteria is that the unit be capable of being started up, operated, and shutdown without aid of the computer. This will be accomplished by manual operation and sub-loop controls normally supervised by the computer. Separate sub-loop controls are to be provided for boiler-turbine operation, remote burner operation, superheater bypass and turbine bypass operations, and other minor functions.

How much automatic data logging is provided?

Approximately 50 unit operating variables and computed values will be logged automatically by typewriter each hour on a preprinted log sheet. Data can also be printed out between logging intervals upon demand.

In addition to the logging typewriter, there is a small



MOCK-UP OF CONTROL CONSOLE with the electrical control board behind it for generating units No. 3 and 4. One unit is operated from each half of the console

line printer for on-demand and alarm print-out. At any time the operator can initiate on-demand print-out for any individual point scanned, or for all points. Off-normal operating condition will be indicated by an audible alarm, a flashing light, and automatic print-out of the time, point identification, and off-normal value. This alarm printer will replace most of the conventional annunciator windows normally found in a control room.

What type devices provide signals to the computer?

Input signals will be derived from conventional steam plant transmitting devices, both electric and pneumatic; thermal-electric converters; thermocouples; resistance elements; electrical contact closures; and pulse-type electrical contact counts. Measurements will be taken of flow, level, pressure, temperature, position, amperes, volts and vars. Megawatt hours will be metered by standard watt-hour meters and transmitted as pulse counts to the computer. Standard off-the-shelf items are used wherever practical.

Output signals will be primarily contact closures derived from a mercury-wetted relay matrix. Five electrical and five pneumatic analog signals will produce modulating set points for sub-loop controls.

How will the boiler flame be monitored?

Monitoring of both pilot and main flame will be accomplished by detectors included in the Forney automatic burner control system to be supplied by the boiler manufacturer. Main flame detection will be accomplished by an optical device and pilot flame detection will be by flame rod. These devices are being designed for use with natural gas, high viscosity oil, and for combined firing of the two fuels.

Are the units automatic on normal and alternate fuels?

The units will be automatic for both fuel oil and natural gas firing, and also for combination fuel firing with one fuel base-loaded. The controls will be arranged so that a cold start will be made on gas fuel only, but changeover to oil fuel will be automatic upon initiation by the operator. Hot restarts may be made on either fuel and both may be cut in and out of service automatically during operation.

Provision will be made for changing fuel to all 24 burners from natural gas to fuel oil in less than three minutes under emergency conditions. This feature is of special value during periods of sudden gas fuel curtailment.

The firing controls will be arranged so that both fuels may be burned simultaneously in all burners. The base fuel will be held by the controls at a preset fixed rate of flow and major changes will be made by the swing fuel. Upon load rejection, when the swing fuel has reached its minimum operating condition, further load reduction will cut back the base fuel. Upon restoration to normal conditions, the base fuel will first be raised to its preset state, and the swing fuel will then be reintroduced.

What automatic controls are provided besides the computer and how are they related?

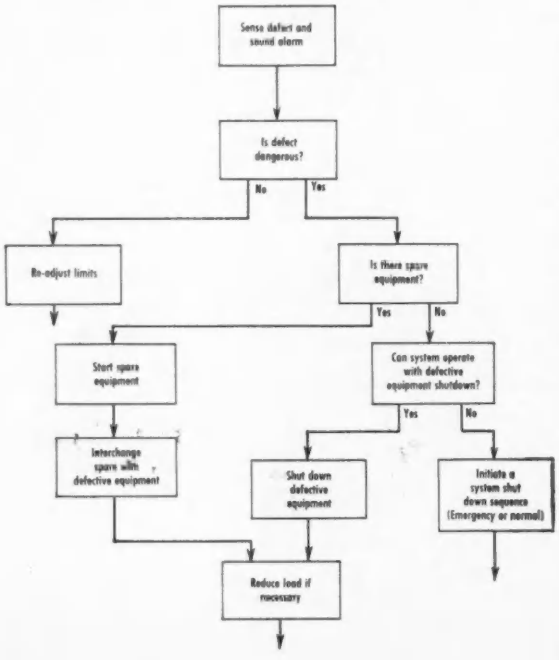
The automatic analog control equipment for units No. 3 and 4 is considerably different than controls found on conventional units because of the universal-pressure boiler. The boiler and turbine must be controlled as a single unit to achieve the highest rate of response.

The primary index of unit requirement will be the area load-frequency control impulse. To this will be applied a bias of generator speed, which will initiate control in case of a power system upset. The adjusted primary impulse, or boiler-turbine master control signal, will be sent to the turbine control valves, the boiler feed water control, the fuel controls, and the forced draft fan controls. With this arrangement, all of the controls act together and in parallel to produce the fastest possible response.

The turbine control will adjust the turbine control valves in accordance with a predetermined method of operation so that a correct relationship exists between turbine load, throttle pressure and control valve position. The feed water control will establish the correct flow and steam temperature will be maintained by adjusting firing rate.

In addition to the boiler-turbine control, there will be special control requirements for the superheater by-pass and turbine by-pass systems. The superheater by-pass valves will be throttled to maintain proper flow and pressure through the boiler during initial flush out, boiler warm-up, water clean-up, superheater boil out, steam line warm-up, turbine warming, and initial turbine loading. The by-pass valves will also act as safety relief valves during normal operation. Similar requirements are placed on turbine by-pass control valves.

General Logic for Corrective Action



Acknowledgement

The author wishes to acknowledge the fine assistance of the many men in the Edison Engineering and Operating Departments; in the Bechtel Corp; in the General Electric Co; Babcock & Wilcox Co; Westinghouse Electric Co; and the Bailey Meter Co who have unstintedly contributed to the design of the systems now being built. Also C. O. Giles of his company for assistance in assembling information for this article. Without the ingenuity, spirit, and enthusiasm of these people, there could be nothing for this writer to report.

Patchboard Speeds Analyzer Programming

A removable patchboard system for a network analyzer drastically reduces non-productive programming time and speeds power system studies. The patchboard, which permits studies to be programmed in advance or changed while the analyzer works on another problem, not only cuts time needed to make a study, but also improves flexibility of programming.

The method provides these advantages:

1. The program can be pre-plugged—saving three to six hours preparation time.

2. Programs can be stored—because there is no need to unplug patchboards to start a new phase of the study, they can be stored for use later.

3. Faster program changes—while the analyzer is working on one problem, a second board can be plugged for a new problem. Patchboard changes are accomplished in seconds.

4. Greater flexibility — ease of making system changes effectively doubles the size of the board and the scope of the problems which can be represented.

5. Constant plugging-error check—when two or more boards are used, plugging can be quickly cross-checked by taking readings on each board. If fixed circuits are plugged correctly, there will be no variation in readings.

The patchboard is only 15 in. wide and 25 in. high and consists of two major parts: a stationary section mounted permanently in the analyzer control center to which the circuit elements are connected, and the removable board which combines the elements in proper sequence by small patchboards. When the board is inserted into the stationary section, the extended plugs on the end of the patchcords contact the fingers of the stationary connections.

BASIC CHECK is made by comparing two patchboards. If circuits are correctly plugged, no variation will be found

Programming checks, which are made on a mirror image on the back of each board, are accomplished by placing an ohmmeter across the pins to check the continuity of each circuit connection.

The patchboard system was designed for use with the I-T-E network analyzer in Philadelphia.

Rats Gnaw Cable for Fun, Tests Reveal

Rats are playful and inquisitive animals, Swedish scientists have concluded. They will attack materials which have no function as food but which might be used as teeth-sharpeners.

The effervescent nature of the rodents was discovered by tests conducted jointly by the cable manufacturing firm of Sieverts Kabelverk and the Swedish Royal Veterinary College at Stockholm to investigate the extent of cable damage and possible rat-proofing techniques.

In the course of the experiments ten female rats—females were found to be more voracious than male rats—were left in a cage with 16 different cord and cable samples. After two days all samples with an outer sheath of soft rubber or plastic material were severely attacked and the copper wiring visible. A nylon cord was altogether consumed. Only two samples covered with steel and aluminum remained intact, though aluminum did not seem to be as effective as steel.

Other tests showed that the hardness of the compound and the type and quantity of PVC resin and plasticizer made it more difficult for the rats, but it did not stop the animals from gnawing. None of a number of rat repellent additives tested could be considered to have the desired rat-repelling effect.

No soft rubber or plastic materials are likely to resist attack, though rigid types in thick sections will probably be damaged only to a small extent. At present only cables with metal sheathing other than lead will give full protection against the animals.

TRANSFORMER AND RURAL LINE OUTAGE SUMMARY Form No. 41

T - Transformer out L - Line fuse blown

Year 1958 — District Marion

Pole No.	Name	T or L	Outage Date, Cause				Transf. Make Year	Miles of Line	Arrestor Valve or Gap Make	City or Rural	Dual Coord. Line	Corrections (Please give dates)
41	Johnson	T	6-3-58 L-SBO	6-8-58 L-SBO			WH			R		MA-89
58		L	6-3-58 L-U	6-8-58 L-U	7-1-58 L-U			6		R		7-2-58 Found damaged insulators on MA 90-10
84	Rogers	T	4-3-58 SS-LOL							R		
74		L	7-3-58 W-LOL					7		R		MA-90
97	Howard	T	6-4-58 A-BP					6½		R		
74		LE	5-1-58 TG	5-6-58 TG	5-11-58 TG	5-22-58 U		7.5		R		Tree trimmed at MA 90-82 on 5-7-58. 5-23-58 Additional trimming was done all along line.
47	Weston	T	1-7-58 I-SS							R		MA-91
66		L	5-8-58 U	5-9-58 U	5-15-58 U			9		R		5-16-58 Found dead birds on CSP transformer on MA 91-84. Bird proofing applied.
72	Adams	T	5-4-58 TRB							R		

Record Helps Reduce "Repeat" Outages

C. C. DURR, Division Supervising Engineer, Indiana & Michigan Electric Co, Marion, Indiana

Simple records have been instrumental in forestalling and reducing outages in the three divisions of Indiana & Michigan Electric Co over the past 15 years. The procedure prevents loss of revenue from unnecessary outages, saves customer outage time, and materially improves relations with customers. Use of the system has shown that repairs or special attention to tree trimming often will eliminate recurring difficulties. Furthermore, the record provides an easy method of analyzing the causes of outages at the end of the year.

A record form like the one illustrated is kept in a book organized by pole number and map area. Daily entries are made of damage and cause of trouble from crew reports. This form identifies pole and area, shows data on the cause of outage, and lists repairs or corrections made.

If more than two outages of the same sort are entered into the record for any pole or length of line, an immediate investigation is made to determine the cause and make corrections. This practice prevents us from overlooking repeated outages, because the crews, dispatcher or foreman assigned to any one call may vary from day to day. Responsibility for keeping and periodically reviewing the records are assigned to the distribution superintendent in each district in each of the three divisions of the company.

To allow brief notation of the source of trouble and damage, a code was developed which covers 18 causes of trouble from accidental ground (AG) to unknown (U) and 27 types of equipment damage from broken primary conductor (BPC) to secondary riser broken (SRB). For special situations, such as two or more line cutouts on the same pole, the direction in which the cutout controls the line is used to identify a particular cutout.

METHODS BRIEFS

Wiring diagrams and instructions sheets kept in large mailing envelopes pasted just inside the switchgear. Sopies of diagrams panel are always readily available to personnel who maintain the switchgear. Copies of diagrams and instructions also are kept in the office file—M. L. Monson, Supt, Municipal Utilities, Fosston, Minn.

New tools and equipment are partly behind the trend toward larger trucks for general line work. For example, hydraulic derricks have replaced standard A-frame derricks. Space is needed for hot line tool maintenance kits, newly adopted 7.2-kv line guards and hose, a new transformer gin, crossarm changer and plastic traffic cones — Central Maine Power Co.

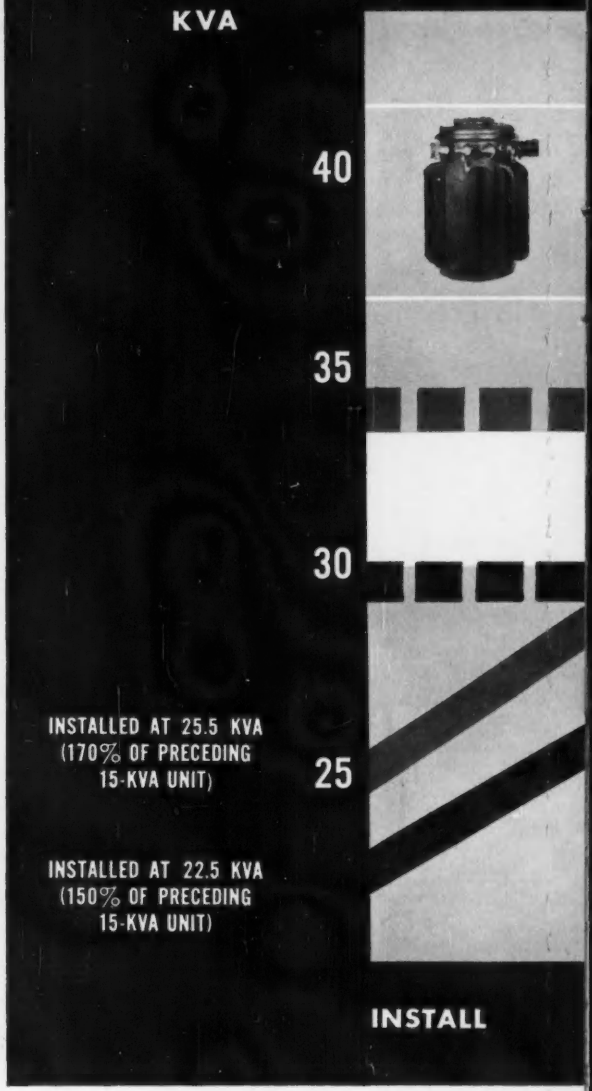
ARE YOU TAKING ADVANTAGE OF THE $ SAVINGS NOW POSSIBLE WITH GENERAL ELECTRIC DISTRIBUTION TRANSFORMERS?

GENERAL ELECTRIC

NEW GENERAL ELECTRIC TRANSFORMER with Permalex* insulation increases loadability by 20 percent with no loss in operating life!

With General Electric Distribution Transformers

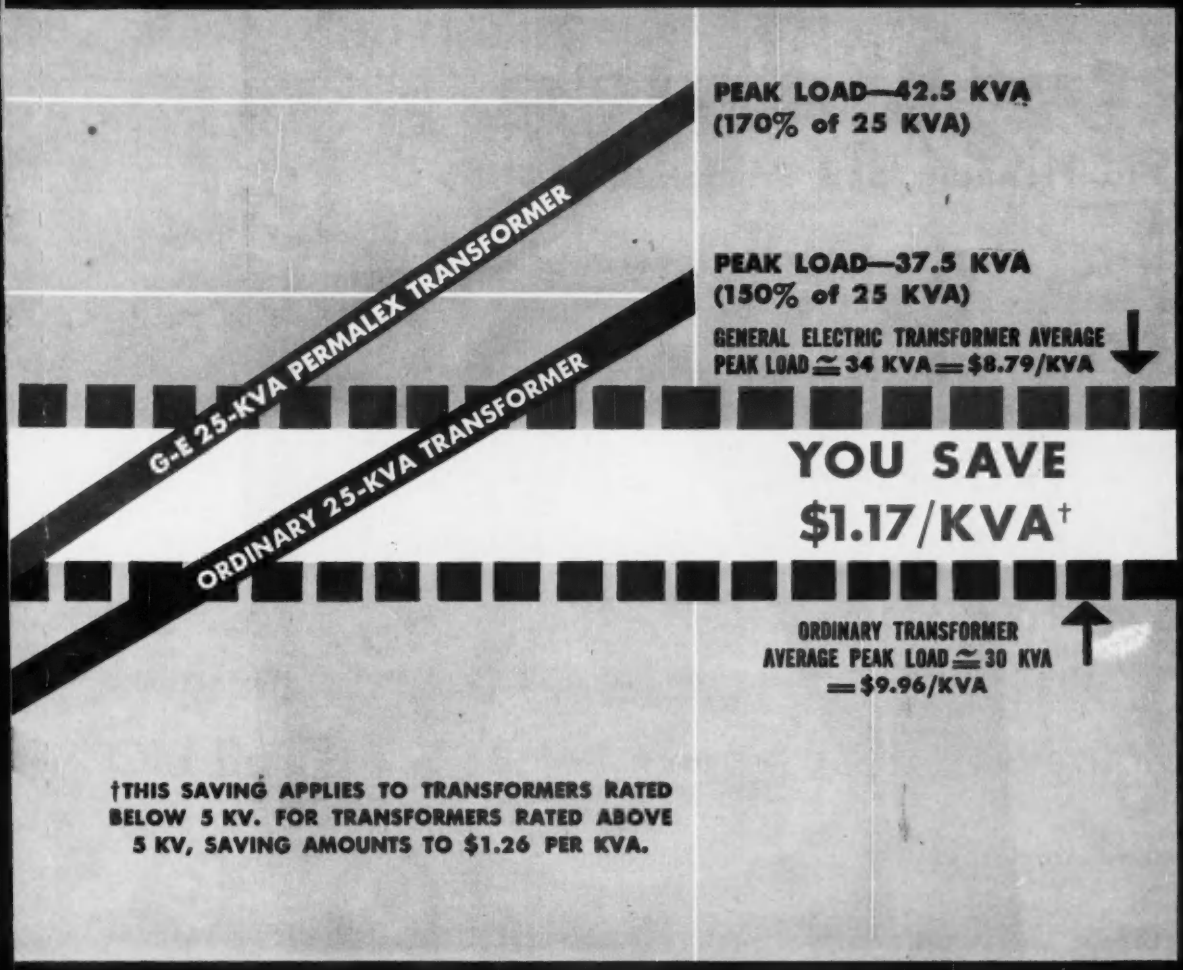
20% Higher Loadability Cuts Transformer Costs Per KVA Of Load Served



New Permalex insulation saves $1.17 per KVA with a 25 KVA transformer.

**Trade-mark of the General Electric Co.*

You get these savings with G-E 25-KVA Permalex transformers


PEAK LOAD—42.5 KVA
(170% of 25 KVA)
G-E 25-KVA PERMALEX TRANSFORMER
PEAK LOAD—37.5 KVA
(150% of 25 KVA)
GENERAL ELECTRIC TRANSFORMER AVERAGE
PEAK LOAD ≃ 34 KVA = $8.79/KVA
ORDINARY 25-KVA TRANSFORMER
YOU SAVE
$1.17/KVA†
ORDINARY TRANSFORMER
AVERAGE PEAK LOAD ≃ 30 KVA
= $9.96/KVA
†THIS SAVING APPLIES TO TRANSFORMERS RATED BELOW 5 KV. FOR TRANSFORMERS RATED ABOVE 5 KV, SAVING AMOUNTS TO $1.26 PER KVA.
LOAD SERVED
CHANGE OUT

General Electric's new distribution transformers through 167 kva handle up to 20 percent greater overloads—with full operating life. This added loadability can reduce your transformer investment per kva of load served. Here's why:

On the average, transformers are changed out when peak load reaches 150 percent of rated load. With Permalex insulation in General Electric's new transformers, you can reach 170 percent of rated load before changing out.

As shown in the example above, a 15-kva transformer would normally be changed out when peak load reaches 22.5 kva. A 25-kva unit would then be installed and used until the load increased to 37.5 kva. The average peak load on this ordinary transformer would be 30 kva. Since the net price of a 25 kva, conventional, no tap, transformer below 5 kv is $299, the resultant cost is $9.96 per kva of load served.

With General Electric's 20 percent added loadability, a 15-kva transformer would be used until the peak load reaches *25.5 kva.* A 25-kva unit would then be installed and used until the load reached *42.5 kva,* or 170 percent of rated load. The average peak load of the G-E transformer would then be 34 kva. Again, since the price of the 25-kva transformer is $299, the resultant cost is $8.79 per kva —or a saving of *$1.17 per kva of average peak-load capacity over ordinary transformers.*

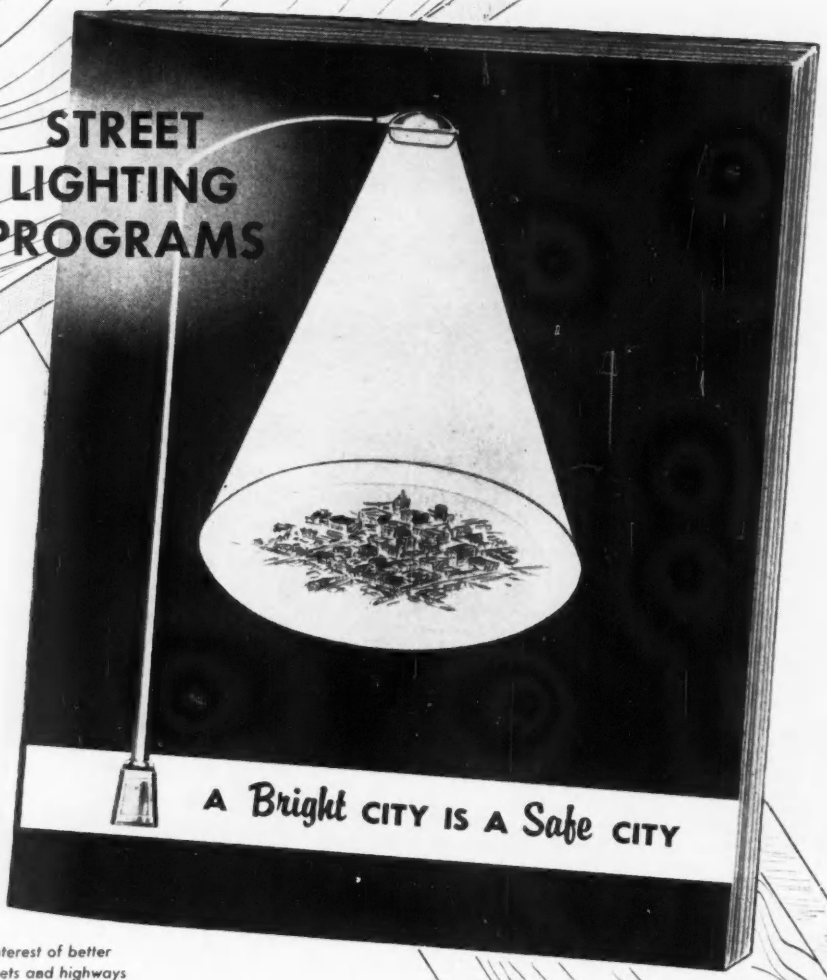
Are you taking advantage of this dollar-saving opportunity? For complete information on how you can make Permalex insulation pay off, contact your G-E Sales Engineer, or write for bulletin GEA-6070 to Sect. 431-89A, General Electric Co., Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

free guide

to Planning and Promoting . . .



Published in the interest of better lighting for our streets and highways

Here is help for those planning street lighting programs. Our new 20-page guide, entitled "A Bright City is a Safe City", contains charts and tables on traffic volume, light intensities, pole spacing, mounting heights and other valuable information. It also describes and illustrates re-lighting programs of specific cities and towns. Just write us—on your letterhead, please—for your copy. Address: Dept. E-1.

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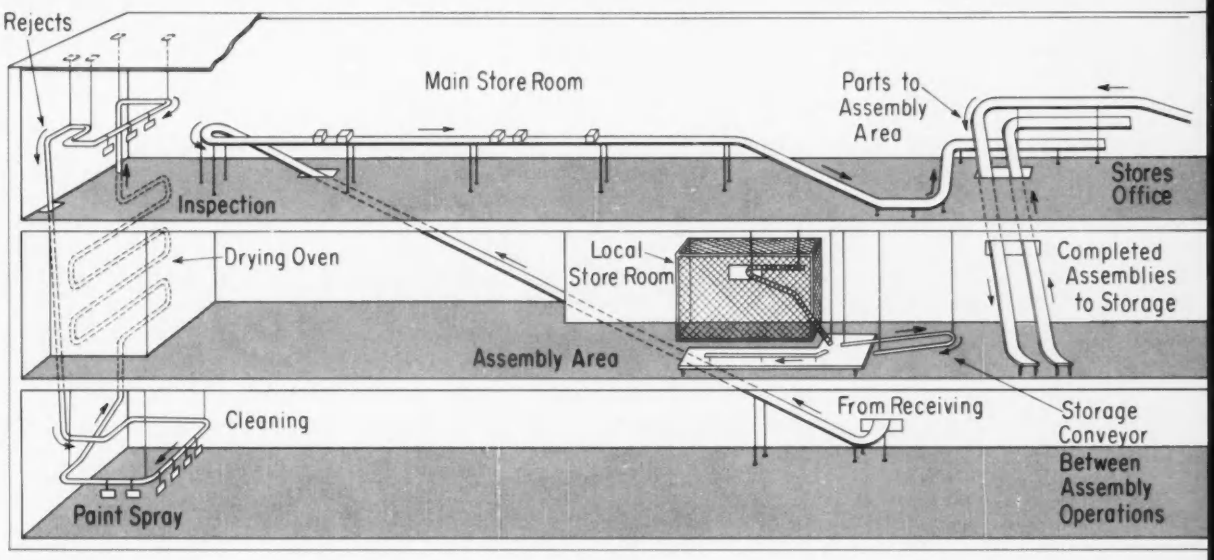
STREET LIGHTING & TRAFFIC SIGNAL STANDARDS—SIGN STRUCTURES—IN STEEL & ALUMINUM



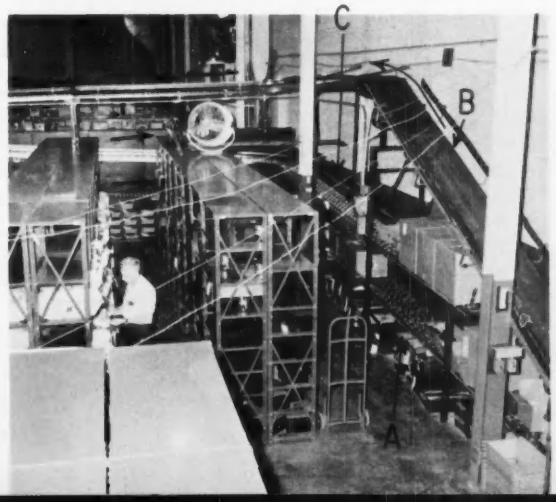
Using conveyors to smooth flow, Westinghouse proves . . .

Old Buildings Don't Have to Be Inefficient

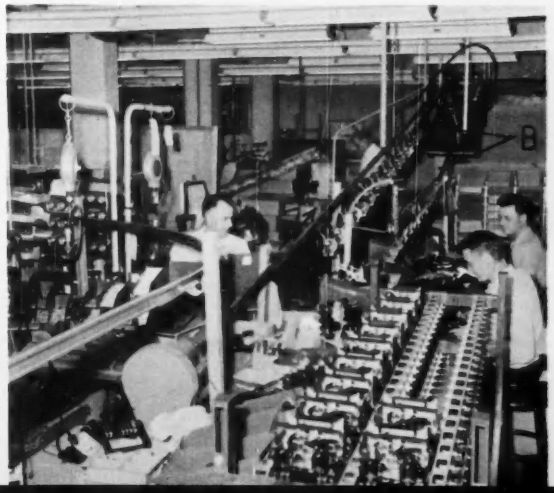
Rebuilding a production line with modern materials handling techniques salvaged an inefficient old 4-story factory building and avoided a costly move to new facilities for the Westinghouse Relay Div in Newark, N. J. Supplemented by higher lighting levels and increased air conditioning, the new materials handling facilities have smoothed production flow, eliminated needless handling operations, and improved employee morale. Use of electric power in the relay production has increased approximately 30%.

Now, the once overtaxed elevators and crowded aisles are bypassed. Incoming materials flow on an 80-ft conveyor from the initial sorting area to a third floor central storeroom without human handling. From the storeroom, components are fed to the assembly area on one 60-ft belt; completed units return for storage on a similar belt. Within the assembly area, screw conveyors between stages store a backlog of units to keep the line flowing smoothly despite variations in the number of men on the line. In the painting operation, another conveyor carries the metal cases from cleaning, through the spray and drying operations, to the main storeroom three stories above. Lighting in many areas has been more than doubled.

INCOMING MATERIAL from receiving is fed to third floor main storeroom on conveyor A. Conveyor B feeds materials to assembly area, on floor below. C returns finished units.

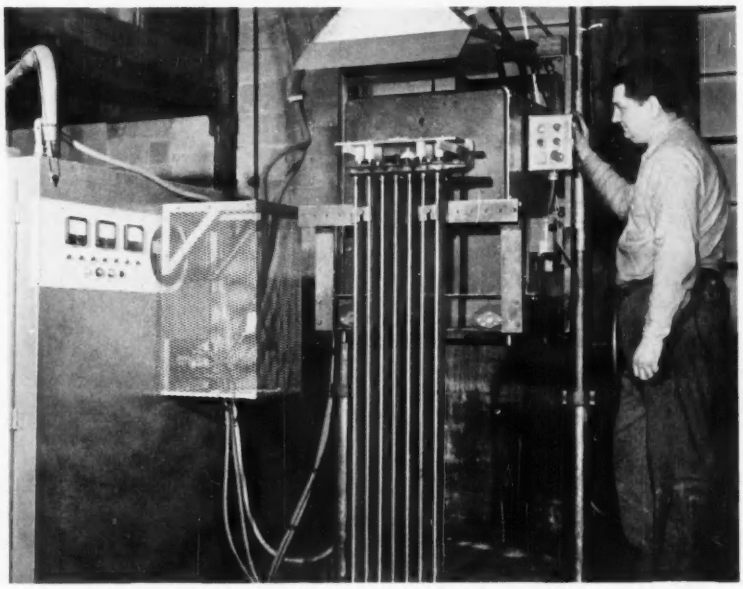


SCREW CONVEYOR A is loaded in local stockroom, feeds components to first stage of assembly. Units are then stored on conveyor B to build up backlog for next operation.



Induction Heat Boosts Output, Ups Quality

THOMAS A. CASEY, Industrial Representative, Pennsylvania Power Co, New Castle, Pa.



A change to induction heating for brazing cooling radiators has improved both the production and the quality of work at the Shaw-Perkins Mfg Co, West Pittsburg, Pa. Made up of banks of steel tubes assembled in headers, the radiators are used to cool circulating oil in large power transformers.

Previously, six men were employed in arc welding and gas welding the tubes to the headers. Arc welded joints often leaked on test and had to be rewelded. Now, two men can handle the entire operation. One operator applies the brazing metal and flux on the assemblies. The other man positions the radiator in the jig and operates the induction brazer. Each tube and header assembly is welded in two to three minutes, depending on the size.

Moreover, the lower brazing temperature minimizes the chance of failure in service due to metal fatigue. The radiators look better and have smoother fillets. With the six annual welders, the company was hard pressed to get orders completed. Now, with induction heating, they can easily meet orders and, in addition, build for stock.

The induction heating equipment has an output of 25 kw at 250 kilocycles. It operates from a 240-v line.

Good Insulation Reduces Heat Pump Investment

CARL LIEBIG, Commercial Representative, Kansas Gas & Electric Co, Pittsburgh, Kansas

Good insulation design eliminated the need for an additional heat pump and enabled the Pittsburgh & Midway Coal Co to heat a 8,600-sq ft office building for only $354 for the winter of 1958-1959. The new office building is of the Williamburg design and structural steel frame, masonry walls, concrete floor, and slate shingle roof over two-inch gypsum planks. It is insulated with six inches of glass wool in the ceiling, two inches of rigid glass wool sandwiched in the walls, and two inches of rigid insulation on the foundation, extending 30 inches below the ground level. The building is separated into four zones, with one 5 -ton heat pump in each.

Use and Billing, Winter 1958-1959

	Heat Pumps			All Other Use		
Period	Kw*	Kwhr	Cost $	Kw	Kwhr	Cost $
9/29 to 10/29	20.00	1,840	23.00	22	4,720	142.03
10/29 to 12/1	24.80	1,840	23.00	23	4,960	147.48
12/1 to 12/31	28.80	7,040	88.00	25	5,040	154.38
12/31 to 1/30	43.20	8,160	102.00	24	5,000	150.93
1/30 to 2/27	32.00	5,360	67.00	24	5,000	150.93
2/27 to 3/31	23.00	2,480	31.00	25	5,440	158.38
3/31 to 4/30	16.80	1,600	20.00	23	5,400	151.88

*Kw demand is 15 minute on heat pump circuit and is not used for billing during the seven heating months.

Original plans were for 7,600 sq ft of space, with four heat pumps and three inches of ceiling insulation. After construction started, 500 sq ft were added to each wing. This additional space would have required a fifth heat pump. However, by doubling the ceiling insulation, heat loss was reduced enough to allow four units to handle the load. The area has a -10F design temperature with approximately 4,500 degree days.

Air distribution is through perimeter ducts in the floor. Wall registers produce a curtain of air on the exterior walls. Air is returned through the corridors.

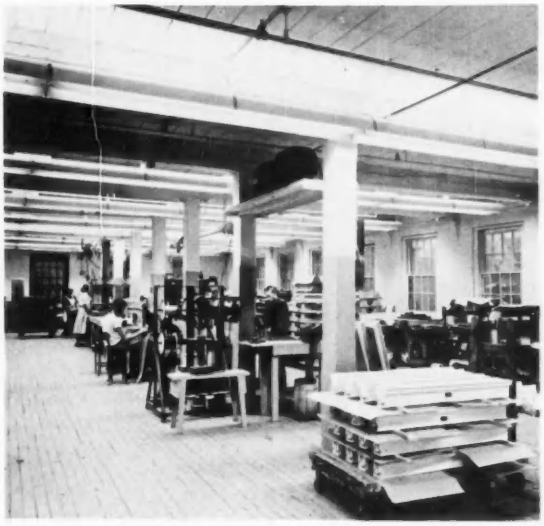
175-Ft-C Lighting Cuts Drafting Labor Costs

D. C. BIXLER, Senior Industrial Sales Representative, Ohio Edison Co, Youngstown, Ohio

A savings in materials, better working conditions, and an increase in output are only part of the benefits of a new lighting installation in the drafting room of the Ajax Magnethermic Corp, manufacturers of induction heating equipment in Youngstown, Ohio. Providing 175 foot-candles of soft shadowless illumination, it also assures a better product and reduces labor costs.

The 100x40-ft room uses a Guth Gratelite ceiling, mounted 12 ft above the floor. The fixtures, mounted 1½ ft above the luminous ceiling, are 40-watt strips on 18-inch centers, with alternate single and double lamps. To assure maximum benefit from the new lighting, the walls are painted light gray. Both the floor and the furnishings are light colored.

Modern Lighting Boosts Output, Cuts Rejects



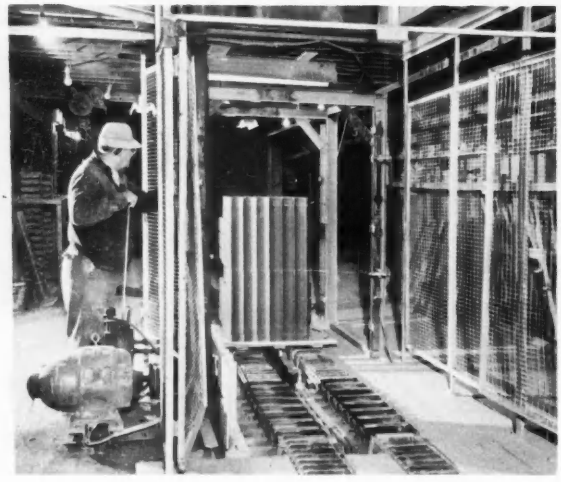
RALPH O. SMITH, Industrial Sales Engineer Connecticut Light & Power Co, Meriden, Conn.

A high level lighting installation using the latest type of equipment is paying real dividends at the Miller Co, in Meriden, Conn. Installed in an assembly area having two different types of assembly problems, the new illumination has boosted production, and made a substantial reduction in the number of rejects. An intangible but definite benefit is the improvement in the employees morale as a result of the decrease in glare from the work.

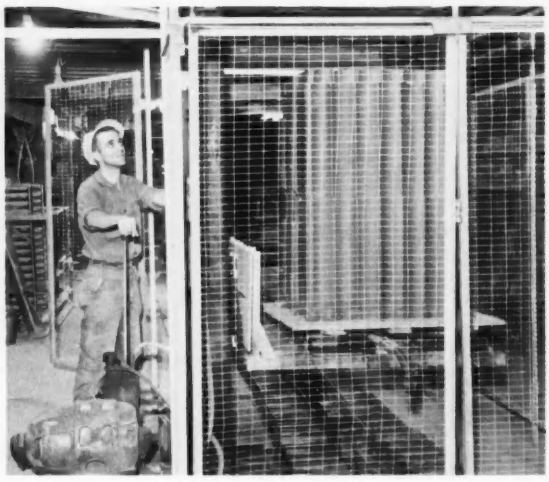
Using the new Power-Groove lamps and a semi-specular alzac aluminum fixture, the installation provides high level lighting with a minimum number of fixtures to install and maintain. The lighting was designed to provide 110 foot-candles of average maintained illumination, 10 foot-candles above the new Illuminating Engineering Society minimum for this type of work. However, at the time the picture was taken, the equipment was still delivering 150 foot-candles of comfortable, low brightness illumination.

What's Your Production Problem?

If you have problems in lighting, drying, casting, forging, painting, or materials handling, consult your local power company. Let their experienced specialists show you how to cut costs with electric power.



Motorized line cuts clay forms, then . . .



lifts them to curing area as . . .

Automation Speeds Mold Cover Production

W. F. HUTCHINS, Industrial Power Engineer, West Penn Power Co, Ridgway, Pa

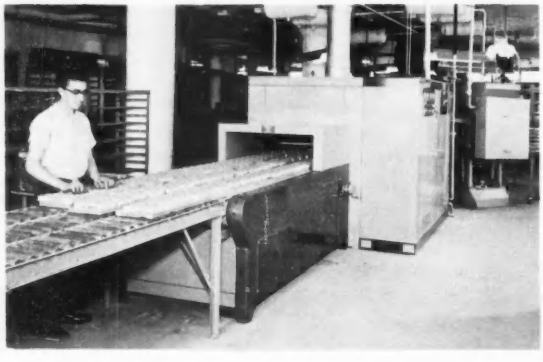
Letting an electric motor do the hard work has turned a once costly, laborious, and time consuming method of handling refractory hot tops into a one-minute operation with only two men at the Kaul Clay Co in Clermont, Pa. Made of clay, the refractory hot tops are produced in various sizes to fit the tops of ingot molds in steel mills. The tops are made as sections of continuous columns and then sliced precisely between the sections before the clay is fired.

Formerly this was done by hand. After placing a template over the unfired column, three men cut the sections apart by drawing piano wire diagonally through the appropriate slits. Although much time, labor, and good guesswork were used, rejects were still high.

Now piano wires are strung horizontally between vertical posts at the proper height for each slice. The unfired column stands on a pallet which is guided through the wire network by an endless cable in the floor. The operation is faster, the slicing is accurate, and the spoilage is way down.

The column then moves to the elevator which hoists it to the floor above for curing. Total time from the moment the column enters the cutting area until it is deposited on the elevator is only one minute. Kaul's management is pleased with the savings from this first step toward automation and plans to automate the entire process of making hot tops, sewer pipes, and other clay products.

Dielectric Heating Cuts Core Rejects 98%



CARL LOPER, SR, Electrical Applications Dept, Allis-Chalmers Mfg Co, Milwaukee, Wis

Dielectric heating reduced rejects due to defective cores to less than ½% at the Rockford Brass Works, a manufacturer of brass plumbingware castings in Rockford, Ill. Rejects of the same core ran as high as 40% before dielectric heating equipment was installed for core baking. Equally important, the automatic oven reduced core baking time by 80%, to an average of 15 minutes from green core to one ready for use. Previous baking time ran about one hour and fifteen minutes for a comparable core.

ORGANIZATION **Formalized procurement-engineering liaison is paying off** for one of the big space research firms, and a modification of the idea may be applicable in utilities. What Space Technology Laboratories has done, reports Purchasing Week, is to establish a team of Procurement Liaison Engineers under the purchasing department. These men report to the manager of procurement, but keep in close touch with engineering developments to anticipate the technical product needs. They also brief vendors on general technical activities of the company and keep tabs on new products. But their job ends with the writing of the requisition.

POLICY ▶ **Salvage Section of B. C. Electric Co gives nod to local firms** in the sale of scrap metal and other surplus material. The company policy of assisting British Columbia industries requires that local firms have a priority over foreign buyers. Since the section was created in 1950, it has sold approximately $4 million worth of salvage materials.

SUPPLIERS ▶ **I-T-E Circuit Breaker Co offers its complete line** of liquid-filled and dry-type distribution and power substation transformers for sale directly to utilities and industry. The company has produced transformers since 1948—but solely for use in its own rectifier and unit substation products. Substation transformers are available in ratings from 112.5 through 10,000 kva for 3-phase units, and 100 through 3,333 kva for single phase. Primary voltages range to 69 kv.

Federal Pacific Electric Co will attempt to acquire Cornell-Dubilier through exchange of stock, subject to approval by Federal Pacific stockholders Feb. 8. Octave Blake, president of Cornell-Dubilier, favors the proposal. If consummated the Cornell-Dubilier electrical product line will be integrated into Federal Pacific lines.

VALUE ANALYSIS ▶ **"Value analysis, perhaps more than any other single aspect** of purchasing, points up the great need for cooperation and coordination among the various functions and responsibilities of an industrial organization," says Purchasing Director W. W. Crawford, U. S. Steel Corp. "We in purchasing, for example, must maintain a free flow of information both to and from the operating, engineering, traffic, sales, accounting and law departments. It is important to utilize the special knowledge of these departments, otherwise, the procurement officer may tend to relegate the purchasing decision to price alone. Nothing could be more unsound, for initial cost, of itself, in no way depicts true value. That value can only be based on ultimate cost."

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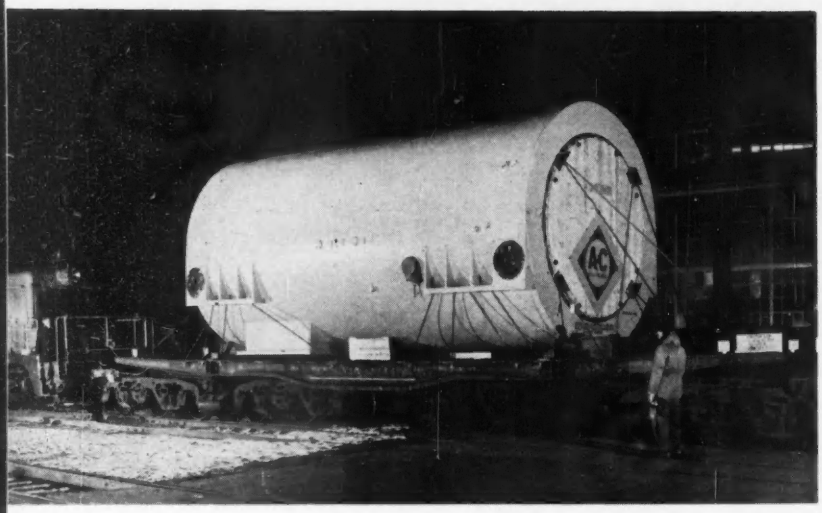
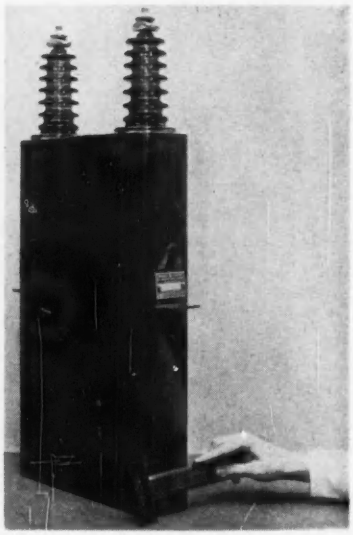


A-C Ships 250-Ton Stator to Houston

This 250-ton generator stator (left), bound for Houston Lighting & Power Co's T. H. Wharton station, is the heaviest single shipment Allis-Chalmers Mfg Co ever has made from its West Allis works. It will serve the A-C 220-Mw Unit #2 at the utility's outdoor power plant north of Houston.

A special steel decked flatcar, restricted to travel a maximum of 25 mph, was furnished by Pennsylvania Railroad because of the stator's weight and its height: almost 18 ft from the rails.

Smaller, Lighter Capacitor Developed



General Electric is producing a 50-kvar capacitor (right), the Compact Isokraft 50, which, because of weight and size economies, contributed to the 5% price reduction in capacitors which GE recently announced, says W. G. Hart, manager of power capacitor sales.

He points out that the new unit weighs 82 lb, which is 17 lb less than the Isokraft 50 capacitor introduced by the company last July. It is also 20% smaller. This weight and volume savings were achieved without reducing the capacitor's effective cooling area. Weighing about the same as many 25-kvar units now in use, the new capacitor is nearly 40% lighter than a great number of 50-kvar units. Height and width dimensions are the same as those of the Isokraft 50.

Distance between the mounting holes is NEMA standard 15⅝ in., making the Compact Isokraft 50 suitable for installation in any NEMA standard capacitor hanger or rack.

The Isokraft paper dielectric has been improved through continuing research by GE since it was introduced in 1959. Refinements in quality control and manufacturing techniques permit greater utilization of its lower, flatter watts loss characteristic and high dielectric strength.

141 HV Switches Ordered For Niagara Falls Project

I-T-E Circuit Breaker will supply 141 high-momentary switches to route and sectionalize high-voltage power for the Lewiston hydroelectric generating plant now under construction. The order will be completed and shipped from the Greensburg Division by next August. An I-T-E spokesman says that the contract, received from the New York Port of Authority, is "in the high six-figure" neighborhood.

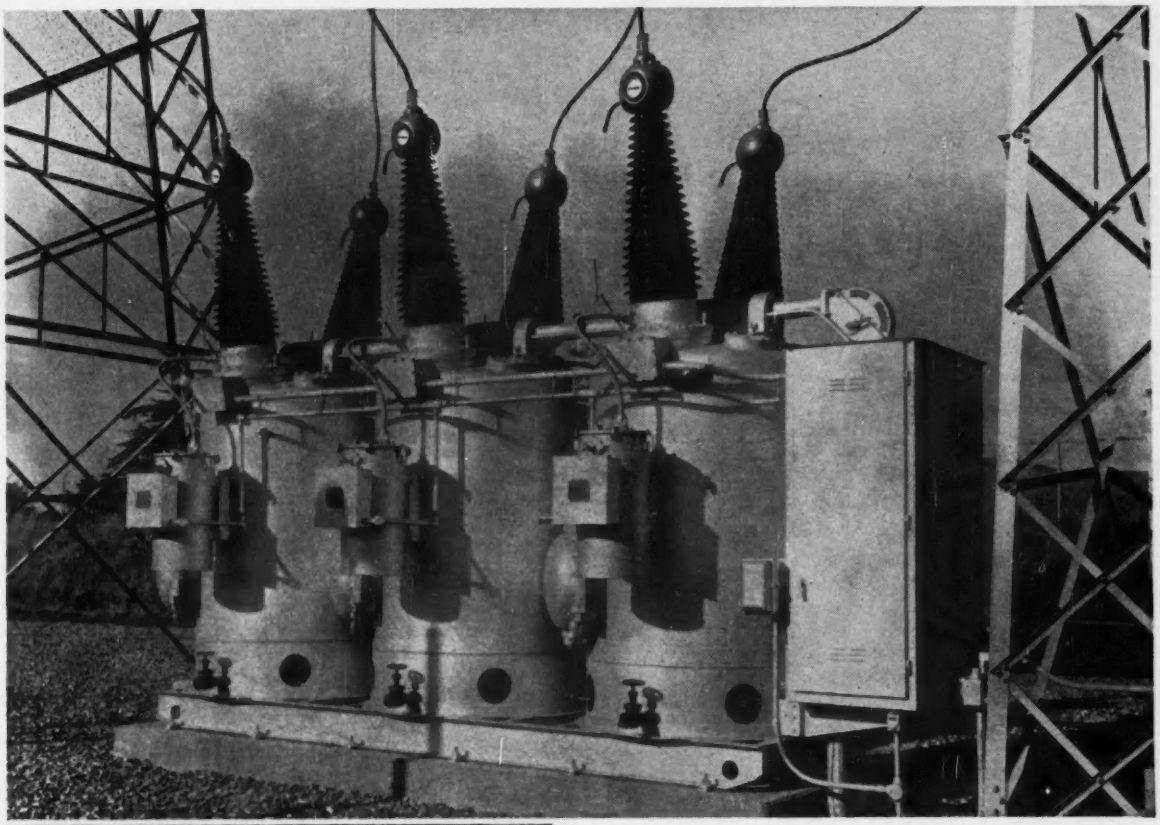
The switch order includes a total of 78 115-kv switches, shipped in 1959, and 63 230-kv switches scheduled for delivery by August of 1960. All the switches have momentary current ratings of 80,000 amp and continuous current ratings of 1600 amp. The 115-kv units have 550-kv BIL ratings and 230-kv switches will have 900-kv BIL ratings.

For high performance operation at high voltages the switches have these design features: straight-line current flow; high-conductivity jaw arrangement; corona-free contouring of live parts; full phase-to-phase clearance in any position, and easy one-man operation.

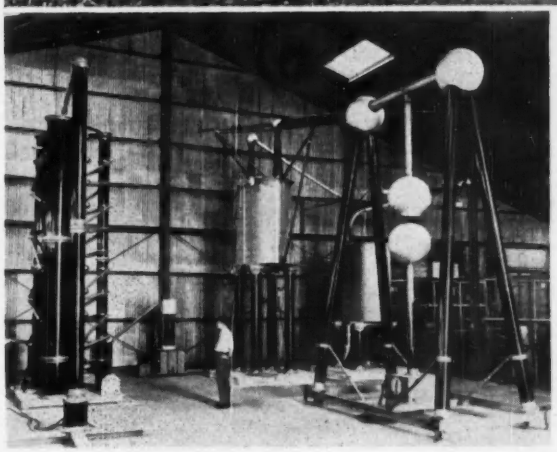
The current passes from terminal to terminal in a straight horizontal path, and because of this arrangement there are no stray magnetic forces to blow the blade open.

(*More Manufacturers News, p* 74)

I-T-E OIL CIRCUIT BREAKERS NOW OFFERED NATIONWIDE



Typical I-T-E oil circuit breaker on 115 kv transmission circuit. Capacity is 1200 amp continuous, 3500 mva interrupting.



Division Test Laboratory. For testing power circuit breakers at the Los Angeles oil circuit breaker plant. Shown are 1.5 megavolt surge generator, 666 kv transformer supply, and sphere gap stand.

This new addition to I-T-E's line of products for electric utility companies is backed by over 50 years of oil circuit breaker experience. Thousands of breakers have been purchased and installed by West Coast utility companies during this period. Now they are being offered nationwide through I-T-E's coast-to-coast sales organization.

I-T-E oil circuit breakers are the product of one of the newest I-T-E divisions, the Kelman Power Circuit Breaker Division. Formerly the Kelman Electric and Manufacturing Co., it joined the I-T-E family just a few years ago. Oil circuit breakers now become full-fledged partners of the other products which I-T-E offers to utility companies: metal-clad switchgear, isolated phase bus, outdoor high voltage disconnect switches, and outdoor substations.

I-T-E is ready to serve your needs anywhere. Improved and expanded facilities for producing and testing oil circuit breakers insure prompt delivery and highest quality. Ratings range from 14.4 kv to 230 kv and from 100 mva to 15,000 mva. Get complete information from your local I-T-E representative. Or write I-T-E Circuit Breaker Company, Kelman Power Circuit Breaker Division, 1667 North Main Street, Los Angeles 12, Calif.

I-T-E CIRCUIT BREAKER COMPANY

Crapo

GALVANIZED STEEL STRAND FOR GUY, MESSENGER and OVERHEAD GROUND WIRE

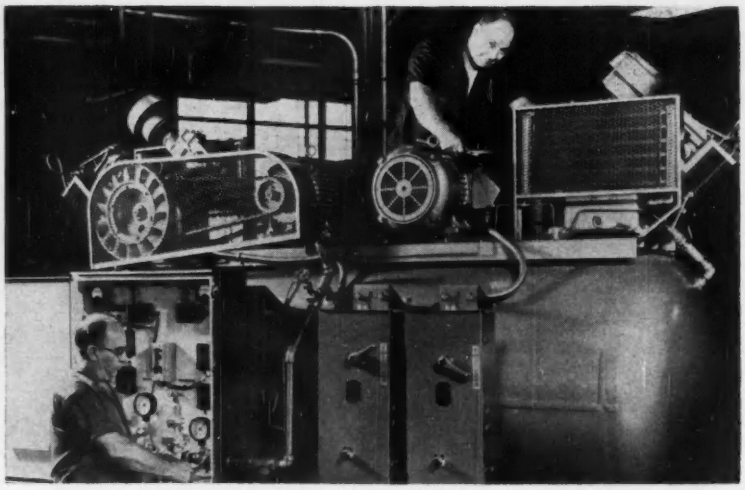
The high, uniform, consistently-dependable quality of Crapo Galvanized Steel Strand is the direct result of close laboratory control over each step in manufacture. All wires used in forming a particular size and grade are produced from steel of selected analysis, carefully processed under technical supervision and stranded on precision machines. Both wire and finished strand are subjected to prescribed laboratory tests to insure the desired end result.

Heavy, uniform, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide maximum resistance to corrosion.

Write for booklet OG-25 containing "Sag and Tension Data for Overhead Ground Wire."

INDIANA

STEEL & WIRE CO., INC., Muncie, Indiana



Worthington Ships Air Compressors

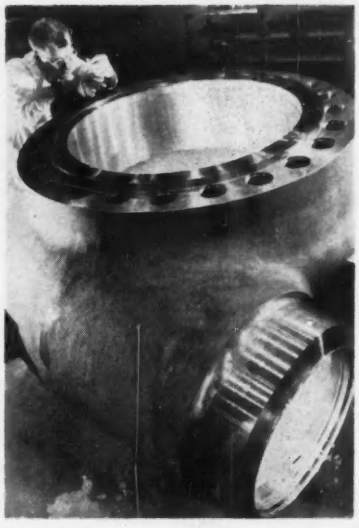
At Worthington Corp's Holyoke Division, workmen ready one of three tank-mounted air compressor units (above) for shipment to Westinghouse Electric International Corp for installation in Palo Seco steam electric plant, San Juan, Puerto Rico.

The units, designed for outdoor, subtropical, sea level operation by the division, will be used for operation of contacts on large circuit breakers and to extinguish electrical arc occurring when contacts open as result of short circuit or overload. They are conditioned to withstand exposure to moist, salt atmosphere and tropical rain storms with wind velocities up to 150 mph.

Each dual-mounted, parallel-connected air-cooled compressor will deliver 30 cu ft of air per min at a pressure of 500 lb per sq in to the 720-gal air tank. Each is equipped with special controls for automatic start-stop operation with one or both compressors running, or with either compressor leading and the other backing up air supply, depending upon demand.

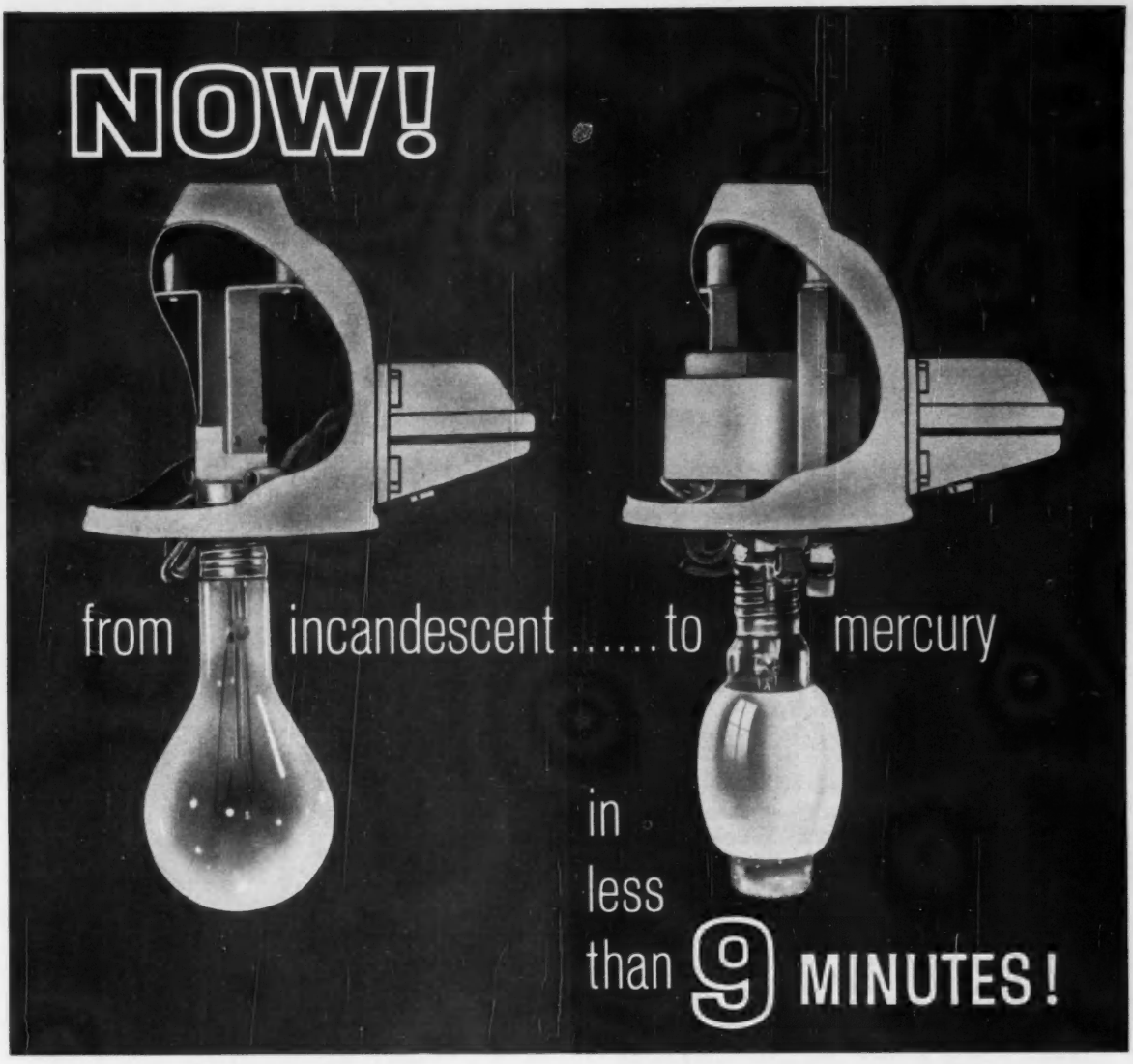
8-Ton Yankee Atomic Volute Readied

A technician in Westinghouse Electric Corp's atomic equipment department is checking this 16,000-lb canned motor pump volute (right) for dimensions on the threads for bolts which will hold the upper portion of the pump in position. When completed, the 1600-hp motor pump will be shipped to Yankee Atomic Electric Co's 134-Mw nuclear power plant at Rowe, Mass.



Along with three other units, the pump will circulate radioactive water at 496F through the nuclear reactor system at a rate of 23,700 gal per min at a system pressure of about 2000 lb per sq in. Pressure rise across the pump will be 80 psi.

(*More Procurement & Products, p* 76)



...with new Sylvania Mercury Conversion Kit

Sylvania now brings you simplified, timesaving conversion kits for mercury lamps that let you triple your light output, save operating dollars—*without the penalty of high installation costs.*

These kits permit conversion of your existing heads to mercury in one easy operation. They're designed for EEI-NEMA type heads, and because the ballast is built right into the kit, time-consuming installation of remote-mounted ballasts is eliminated. Sylvania also offers the reactor separately for adaptation for other in-head ballast assemblies, and special mounting brackets where equipment requires.

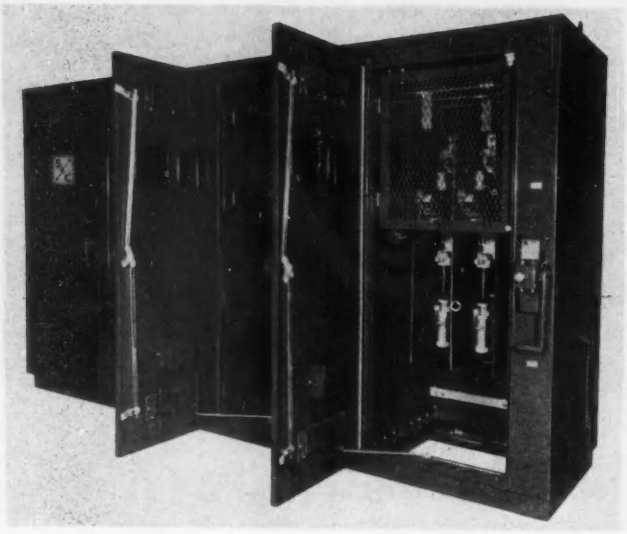
For technical details write for our new descriptive brochure on Sylvania Mercury Conversion Kits, Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Ipswich, Massachusetts. In Canada: Sylvania Electric (Canada) Ltd., P. O. Box 1190, Station "O," Montreal 9.

SYLVANIA

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

(For further information refer to Readers Service on page 78)

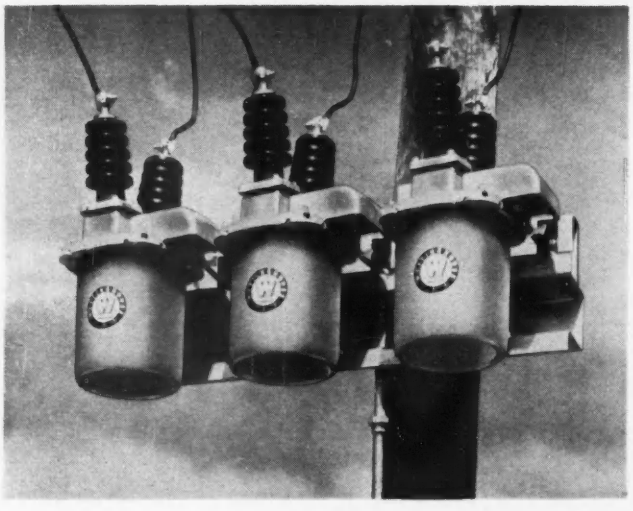


Metalclad Switchgear . . .

. . . is rated as high as 44,500 amp fault-closing and 500 Mva short-circuit interrupting at 14.4 kv. Corresponding ratings at 4.16 kv are 60,000 amp fault-closing and 250 Mva short-circuit interrupting. Interrupting duty is provided by a solid-material boric-acid power fuse. The switchgear is available in continuous ratings of 200, 400 and 600 amp, fused. Ratings as high as 1,200 amp are available unfused.
S&C Electric Co, 4435 Ravenswood Ave, Chicago, Ill.

Hydraulic Derrick . . .

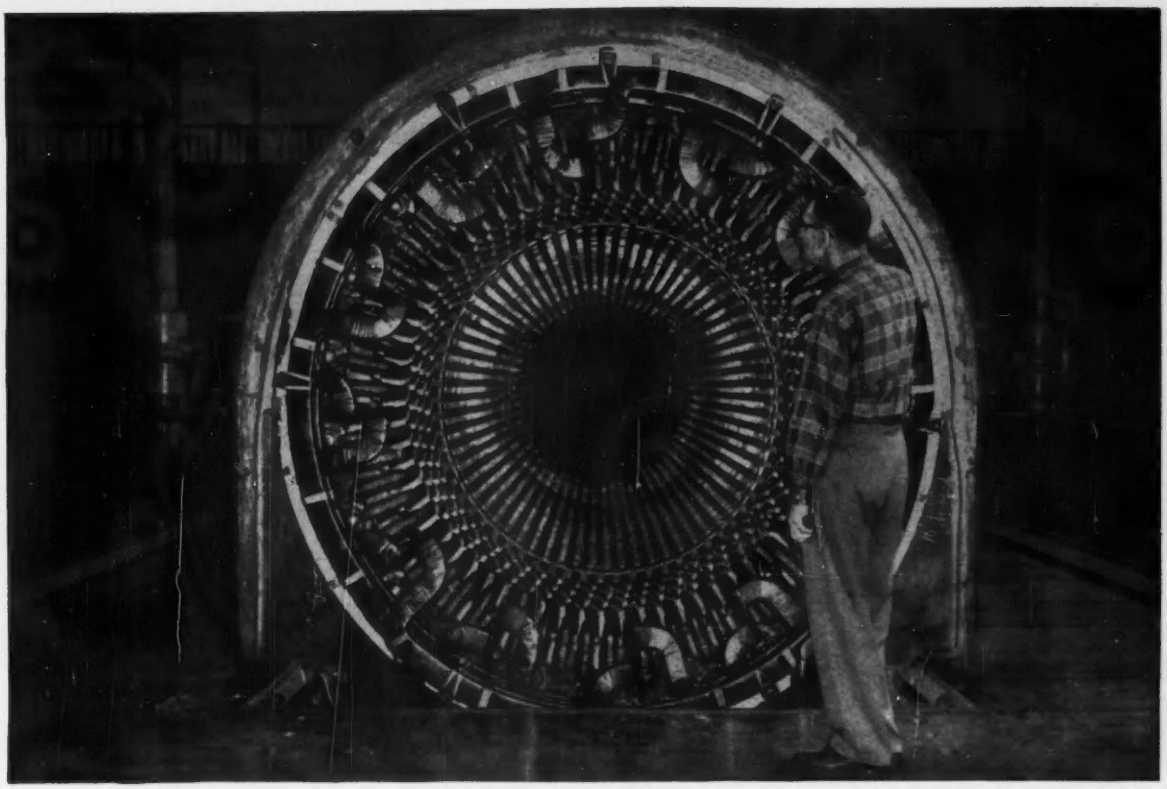
. . . has rectangular side legs and an extra-long middle leg hydraulic cylinder for high strength. The rectangular side legs of the Series 3750 Derrick are additionally braced by a cross support. The middle leg hydraulic cylinder, longer than on previous models, allows the derrick to come closer to the ground for forcing the digger deeper into the soil. The unit has a 12,000-lb capacity and can set poles 75 ft long. One man can raise the derrick in 35 sec, stow it in position in 40 sec. The unit has a working range of 195 deg.
Holan Corp, 4100 W 150th St, Cleveland 35, Ohio.



Oil Switch . . .

. . . is used for pole-mounted capacitors, sports and street lighting, and as a load-break isolating switch on rural and suburban distribution systems. The 200-amp, 15-kv switch (Type CSL) is solenoid-operated and requires only 2 cycles to open and 6 to reclose. The switch has a 95-kv BIL, a momentary current rating of 9,000 amp, rms asymmetrical, and a one-sec rating of 6,000 amp, rms symmetrical.
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

(*More New Equipment on page* 78)



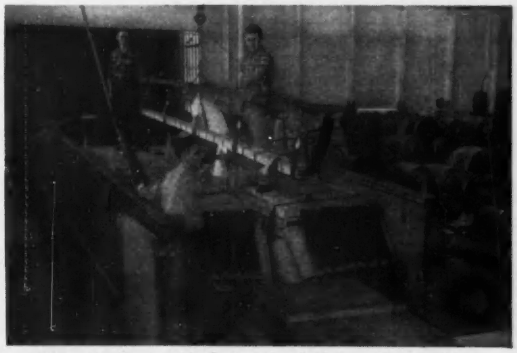
22,000-volt generator rewound with NECCOBOND coils by National

...The Specialists in electric coils/repair service

After years of service, tape separation on the stator coils of this 75,000-KW, 22,000-volt turbo generator made reliability uncertain. Thus Commonwealth Edison Company decided to replace the winding.

The winding was redesigned to employ the NECCOBOND insulation system, which bonds all the coil insulation elements into a solid unit. The insulation now has the high mechanical strength to withstand cycling operation without tape separation.

When you replace high voltage coils, investigate the advantages of NECCOBOND. It is based on time-proven insulating materials—mica and glass. These are welded by a special impregnant into a tenaciously bonded, resilient, voidless insulation wall. A unique method of fabrication assures homogeneous insulation. *For more information call National's Columbus plant... HUdson 8-1151. Or call the nearest National Field Engineer.*



New 27-foot coils being loaded for direct shipment to generator site where rewinding time was substantially reduced.

National Electric Coil

DIVISION OF McGRAW-EDISON COMPANY • COLUMBUS 16, OHIO

Electrical Engineers • Manufacturers of Electrical Coils, Insulation, Lifting Magnets
Redesigning and Repairing of Rotating Electrical Machines

McGRAW EDISON

Readers Service

For additional information on new products, supplies, and services in this issue, the Manufacturers Editor of Electrical World offers his facilities. Check items in which you are interested in list below:

NEW EQUIPMENT

S&C ..... Switchgear ☐
Holan ..... Derrick ☐
Westinghouse ..... Switch ☐
Penn Transformer .... Transformer ☐
Medical Supply ..... Trainer ☐
Biddle ..... Rheostats ☐
Line Material ..... Block ☐

OTHER

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Manufacturers Editor
Electrical World
330 W. 42nd St.
New York 36, N.Y.

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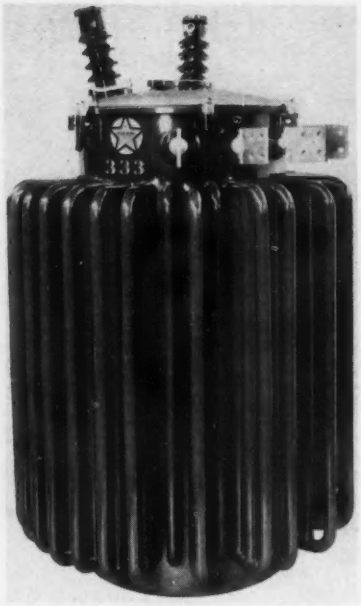
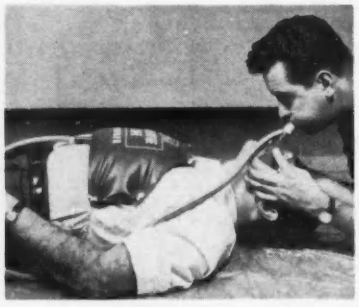
JANUARY 18, 1960



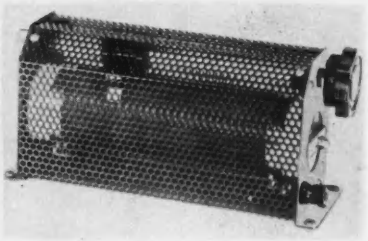
Distribution Transformer . . .

. . . in single-phase 333-kva model extends Featherweight Pole Star Transformer line. The line now includes single-phase ratings of 167, 250 and 333 kva, 15 kv and below. The unit is lighter and more compact than the station-type transformer it replaces and also provides better regulation. Average impedance is 2.5 to 3%.
Pennsylvania Transformer Div, McGraw-Edison Co, Box 330, Canonsburg, Pa.



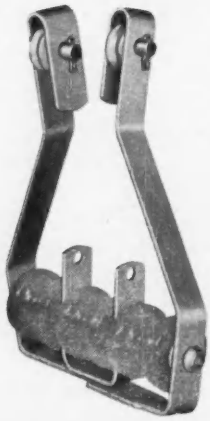
Safety Trainer . . .

. . . helps in learning technique of mouth-to-mouth respiration. The MSco Breathe Life Trainer lets the instructor or trainee accurately simulate all steps of rescue breathing with a study "victim." He can learn how much to inflate a victim's lungs and what possible difficulties he may encounter. Practice is under sanitary conditions without actual mouth-to-mouth contact.
Medical Supply Co, Rockford, Ill.



Rheostats . . .

. . . provide maximum operator safety. The 10-in. Lubri-tact Screw-Drive Cage Jagabi Rheostats have protective metal cages which completely enclose live and hot parts. The metal cages are attached to prepunched end brackets and enclose top, sides and bottom of the rheostats. The cages may be added in the field or at the factory.
James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

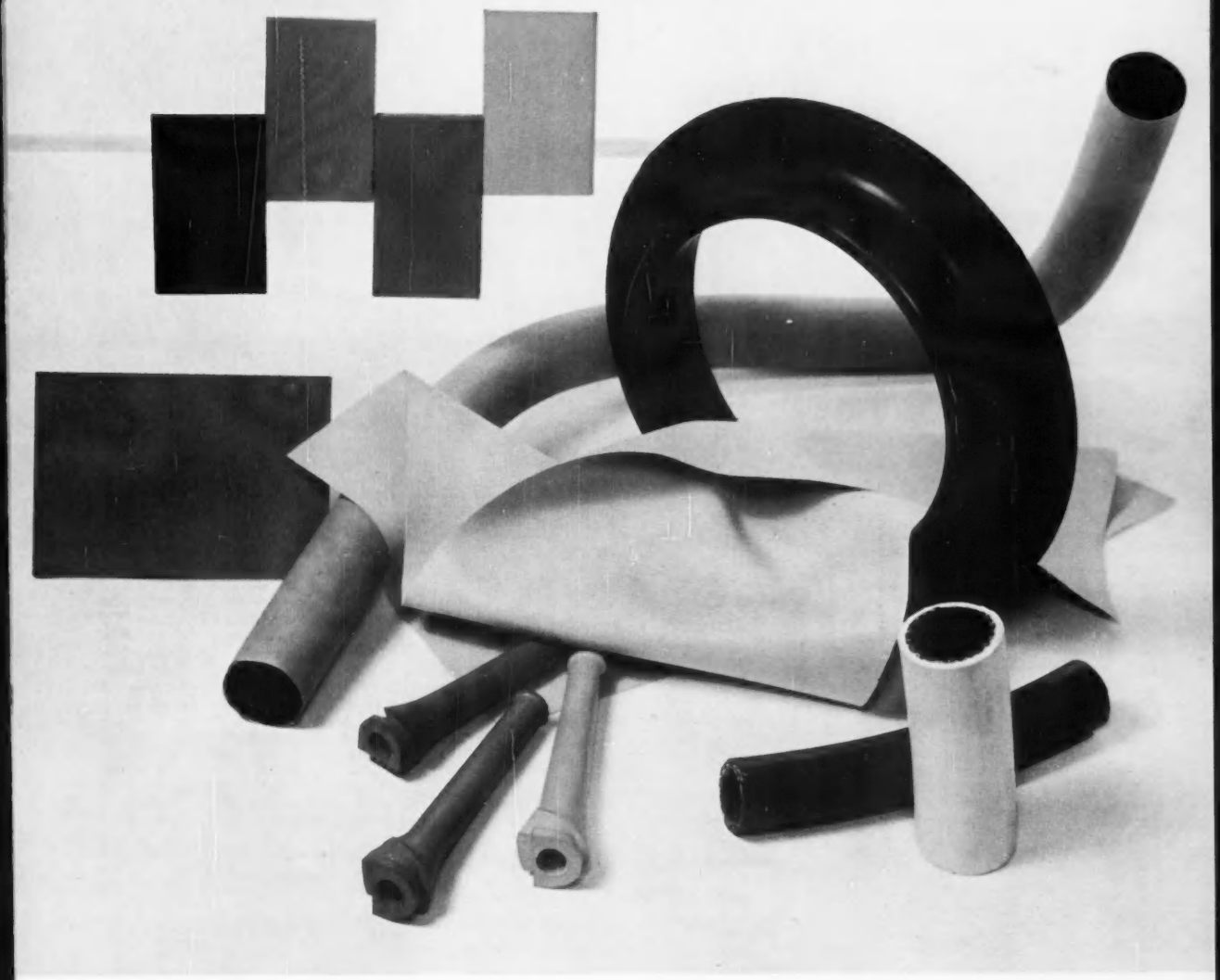


Stringing Block . . .

. . . for spaced aerial cable permits easy placement and removal from both the support messenger and the insulated cables. Opposing-offset design assures positive trolley action of the block and promotes safety. Standard spool-type insulators support the cables.
Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wis.

Naugatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



. . . tough, oil-proof, weather-proof and **colorful, too!**

The samples above should begin to give you some idea of the endless color possibilities in ozone-resistant rubber products made of new PARACRIL® OZO. Now you can give your product color that *sells* . . . color that identifies for coding wire and cable jacketing . . . color that blends or *contrasts* . . . color that works in a hundred ways. And you can give your product other superior properties, too.

Along with color, new weather-resistant PARACRIL OZO gives you a combination of high abrasion resistance, oil resistance, flex life and other valuable rubber properties far surpassing conventional weather-resistant rubbers.

Cast a new eye on the rubber product you make or buy. See the difference color makes. See your Naugatuck Chemical Representative or write the address below for full information on PARACRIL OZO and the advantages it offers.

Naugatuck Chemical

Division of United States Rubber Company

113 P Elm Street
Naugatuck, Connecticut

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TRIPLE LANE TUBE LAYOUT . . .

what it is and how it IMPROVES CONDENSER OPERATING EFFICIENCY

An informative advertisement from one of the nation's most experienced condenser manufacturers

Steam condenser efficiency depends on water temperature and condition, proper maintenance procedures and many other factors. One of the most important is the design of the condenser itself—and *this* is largely a function of tube sheet design.

Triple Lane Tube Layout, a development of C.H. Wheeler Manufacturing Company of Philadelphia, is making significant contributions to condenser operating efficiencies in public utilities and industrial plants throughout the country. Figure 1 shows a C.H. Wheeler Dual Bank Surface Condenser with Triple Lane Tube Layout.

This tube sheet design permits steam to travel through three separate pathways. As a consequence steam penetrates to all condensing surfaces and utilizes to the fullest extent the condensing capabilities of the steam condenser.

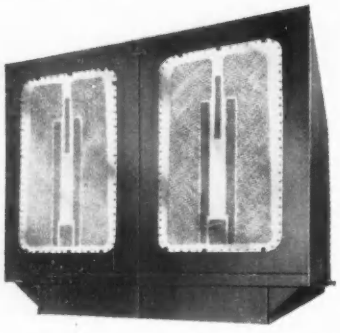


Figure 1: Typical C.H. Wheeler Condenser with Triple Lane Tube Layout.

Central location of the air cooler section, another C.H. Wheeler design feature, also improves steam travel. It reduces the depth of steam penetration and therefore reduces resistance to steam passage, achieving a new low in condenser pressure loss.

How Reverse Flow Improves Condenser Efficiency, Reduces Maintenance

Proper maintenance—keeping tubes and tube sheets free from foreign matter, algae and scale—helps keep condensers operating at peak efficiency. In some cases grass and twigs build up to a point where they would ordinarily have to be shoveled out! It is in such cases that C.H. Wheeler Reverse Flow solves time-consuming, expensive maintenance problems. Here's how it works:

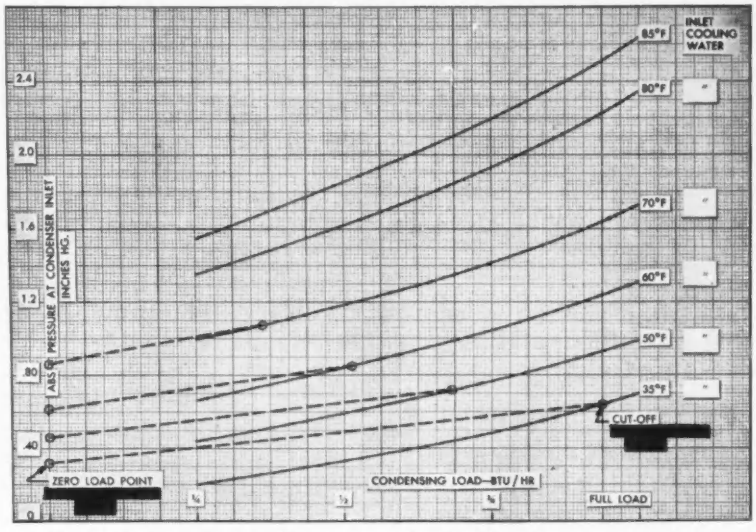


Figure 2: Typical condenser performance curves show how inlet cooling water temperature affects absolute pressure at condenser inlet at varying condensing loads. For a complimentary copy of the 38-page Condenser Handbook from which these curves are taken, write to C.H. Wheeler on your company letterhead.

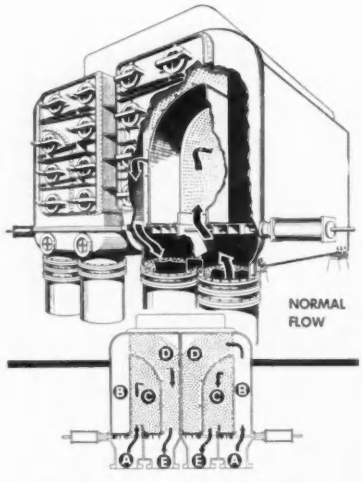


Figure 3: Diagram of C.H. Wheeler Reverse Flow which cleans tubes and sheets during full load operation.

Normal operation is shown on the left in the diagram in Figure 3. Water enters through inlet A with inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser and discharges at E.

The right side of the diagram in Figure 3 shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half of the condenser can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

Because of more-than-half-a-century of experience in condenser design and maintenance, C.H. Wheeler is unusually well qualified to advise on condenser efficiency and maintenance problems. We invite your inquiry, whether you're concerned with condensers or with circulating and condensate pumps and other auxiliary equipment. A note on your company letterhead will receive prompt attention from us.

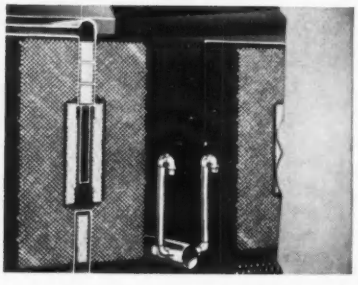


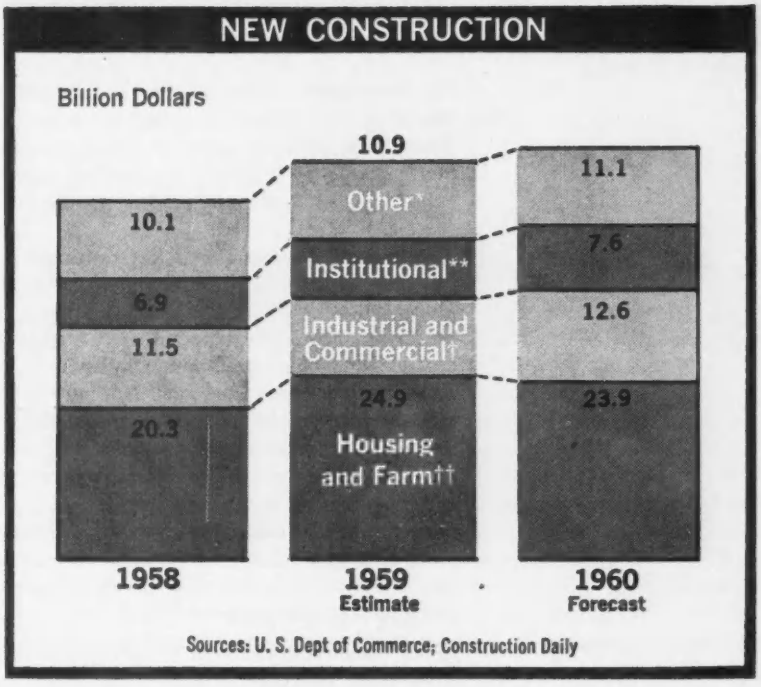
Figure 4: Central location of air cooler section in C.H. Wheeler Condensers reduces depth of steam penetration and therefore lessens resistance to steam passage, achieving a new low in pressure loss in the condenser.

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components



A Hitch in Residential Building

Report on
Electrical Business Outlook

Housing provides almost the only sour note in a chorus of optimism for 1960. It is the only segment of business, in fact, that is heading down as we enter the new decade. And because it is the only laggard in a field of sprinters, housing has lately become the object of some worrying. As the chart above indicates, however, these worries are not very serious at worst. In the first place, the increased tempo of industrial, commercial, and institutional building will more than offset the expected decline in home building; and total new construction activity in 1960 will be running at an all-time peak rate of more than $55 billion—up some 2% over 1959. But even more important, the long-term trend in construction of all types is still upward for the decade of the Sixties.

What then is causing concern? Basically, it's the failure to continue the unprecedented boom that began a year ago. Most of this boom, it should be remembered, grew out of the special construction programs that were created during the recession of 1958, but whose greatest effect did not take place until after the upturn. Then too, construction (and particularly homebuilding) usually hits a peak in the early stages of a business recovery, and then turns down again while the rest of the economy is still booming. This is because "tight money" and other measures to fight inflation tend to restrict construction. That's exactly what's been happening lately.

The homebuilding industry had one of its best years in 1959. But the volume of new home construction in the final months of the year decreased sharply. And new housing starts, which point the direction of homebuilding activity for the coming months, dipped even more sharply. Total value of new residential construction put in place declined from $23.8 billion in May of last year to about $21 billion in November, on a seasonally adjusted annual basis. And new hous-

ing starts, which had been perking along at an annual rate of 1.4 million units in April, had fallen to 1.2 million by November.

Demand Is Still High

The downturn in homebuilding has its roots in the money market; it is not caused by any sudden decline in demand for housing. Builders are having trouble getting new mortgage loans at existing interest rates, and this tight supply of mortgage money is largely the result of tight money generally, which has been deliberately brought on by the government in order to combat inflation.

The Federal Reserve Board has restricted the overall supply of credit in the economy by holding down the lending reserves of commercial banks. This has influenced the banks to "ration" their loans, and mortgage money has become especially scarce. In a period of restricted lending, the banks prefer to concentrate on loans to corporate business—since the latter are generally more profitable than mortgage loans. Not only that, but high interest rates have been tempting many individual savers to put their money into corporate, municipal, and U. S. Government bonds—instead of into the savings banks or savings and loan associations which concentrate on mortgage lending.

One striking example was the loss of nearly $200 million in deposits by mutual savings banks last October—the month when the Treasury issued its new 5% notes. This loss undoubtedly curtailed the savings banks' ability to make mortgage commitments for 1960.

At the same time, the federal housing agencies—whose original purpose was to supplement mortgage lending—have taken their cue from the FRB and cut back on mortgage aids in recent months. During the 1958 recession and throughout most of 1959 these agencies were very active. The Federal National Mortgage Association (or "Fannie Mae", as it is frequently called) purchased more than $1½ billion of mortgages, and the Home Loan Bank put up $850 million to savings and loan associations to use in mortgage lending.

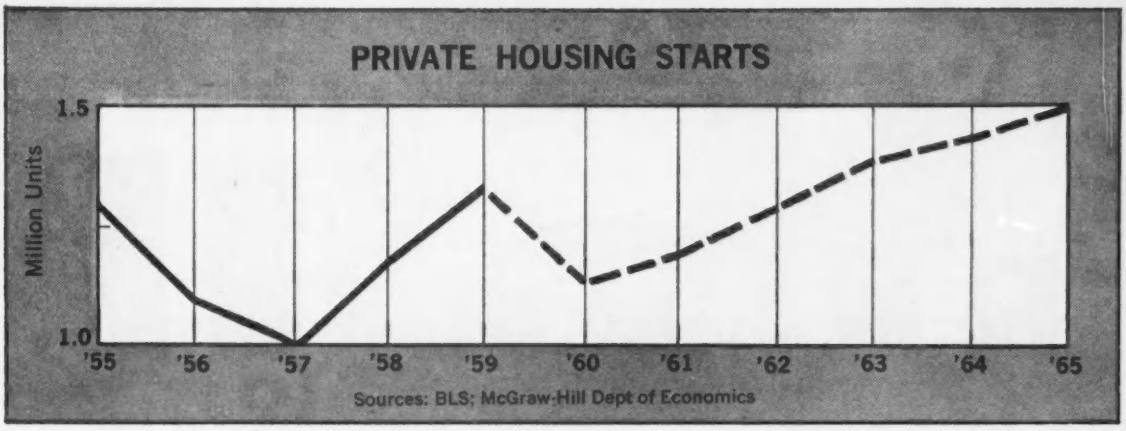
Between them, these two federal agencies provided the funds for about ⅙ of all new mortgage lending in 1959. But late in the year, they cut their advance commitment sharply, and it now appears that they will put up about $1 billion less than they did last year. And this may chop 100,000 units off the number of housing starts that can be financed in 1960. Private lending may be off by that much, or even more.

An 'Off Year' for Housing

The results show up clearly in housing forecasts for 1960: from 1.1 million—or even less—to 1.2 million starts, at most. Some of the expert forecasters disagree as to the length and depth of the decline. But all agree that 1960 will be an off year for home building.

But it's important to remember why 1960 will be an off year, that housing starts are declining primarily for lack of mortgage credit and not for lack of potential house buyers. Actually, surveys conducted by the University of Michigan show that the desire to own a new or better home is one of the most prevalent unsatisfied demands in our economy. This means that if the government should decide to ease credit restrictions in late 1960 or 1961, housing starts may rebound sharply.

The timing of the rebound depends as much on politics as on economics. Regardless of inflation, its always possible that Congress will intervene if housing volume drops too much in 1960. There have already been some suggestions along this



line, and the tightness of credit is sure to appear a tempting target for anti-administration congressmen as the election draws nearer.

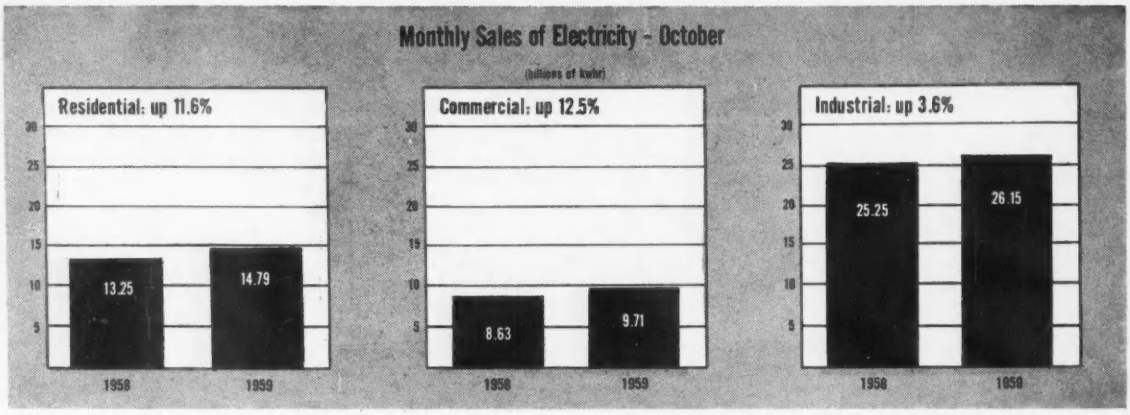
If some action like this is taken, housing may turn up before the end of 1960, but it won't be much before. Even if a bill were enacted as early as May, the process of securing new mortgage commitments and turning builders' plans into actual construction might take as long as six months. If no new housing bill becomes law this year, an upturn is probably as far away as 1961. By that time, the peak of other credit demands may be past, so that more money will become available even without special action by Congress. Any drop in interest rates would drive large quantities of investment funds back into mortgages, since the latter have a fixed rate of interest. And this could end the tight money problem and push up new home starts.

Outlook Is Far From Bleak

Meanwhile, other construction probably will turn in one of its better years. Capital spending by industry has definitely turned the corner—it now looks as though the prospective increase in business investment in new plant and equipment was understated by the McGraw-Hill survey of preliminary plans taken last October. Settlement of the steel strike has removed an element of uncertainty from the outlook, and it now appears that the increase in capital spending for 1960 will reach the vicinity of 12-15% by the time business gets through adding new projects in the months ahead.

Spending for schools, hospitals, and other public institutions by the state and local governments probably will start to rise again before the end of the year, after a recent lag. In institutional construction—as in home-building—present financing difficulties can postpone the fulfillment of a growing demand, but they cannot prevent this demand from being fulfilled as soon as money conditions ease a bit.

Under favorable credit conditions, housing starts could reach 1.3-1.4 million units in 1962 or 1963. And looking further ahead, the volume of new housing seems sure to increase. New household formations will reach 1 million a year by 1965, compared with an average of 875,000 over the last five years. Highway construction and urban redevelopment are adding to the number of old houses torn down (and replaced) each year. And more families are finding it possible to own vacation houses or other second homes. Such market demands are likely to support homebuilding at an average rate of 1.5 million units in the years from 1965 to 1970.



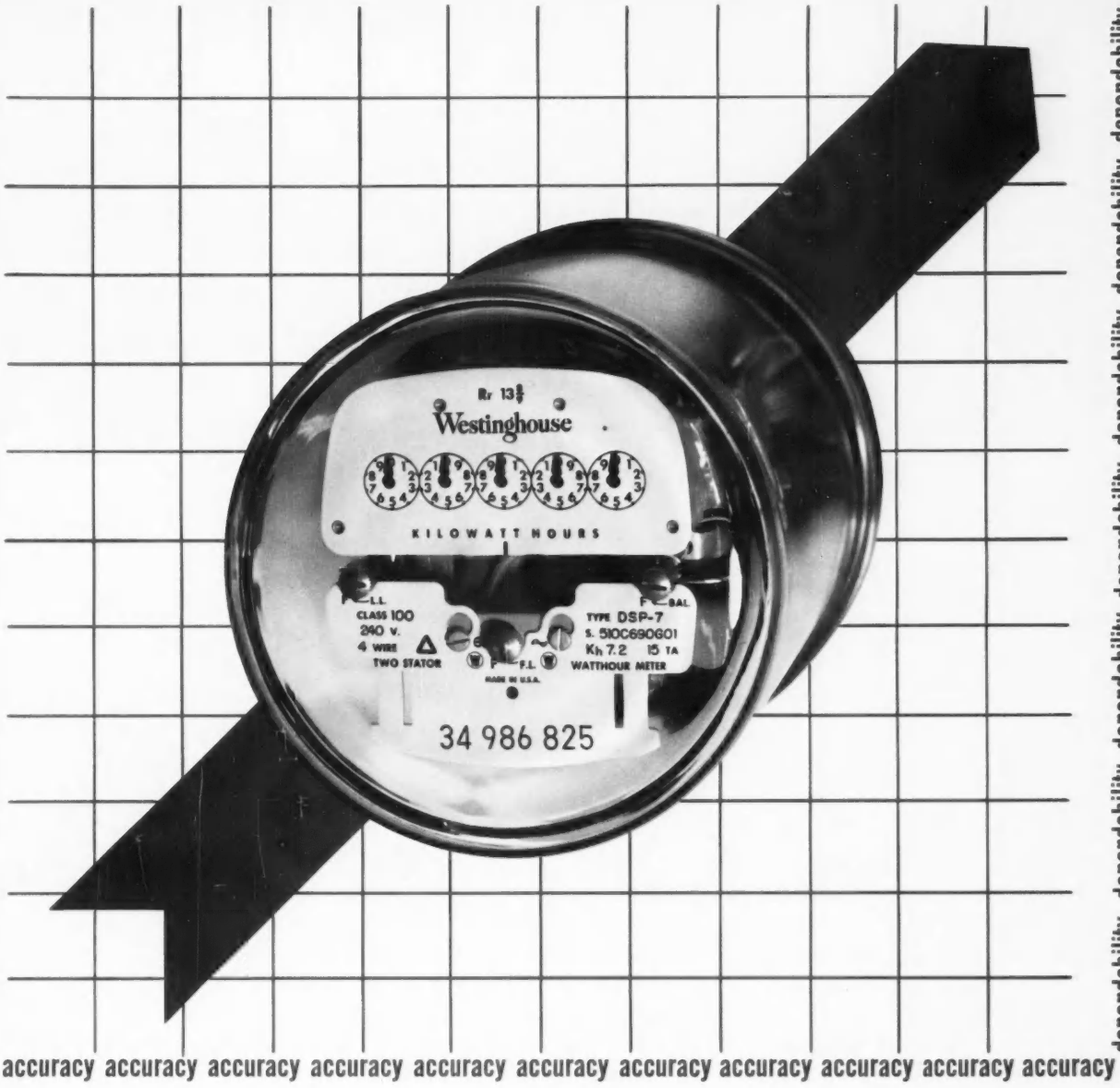
Power Statistics

		Latest Month	Year Ago	Annual Change %
Capacity	Oct.	155.34	138.12	12.5
Est. Dec. '59 Peak (million kw)	Oct.	125.0	127.4	−1.9
Est. Dec. '60 Peak (million kw)	Oct.	134.4	136.6	−1.6
Production—billion kwhr	Oct.	59.03	55.26	6.8
Hydro		11.50	10.81	6.4
Fuel		48.53	44.55	8.9
Sales—billion kwhr	Oct.	53.63	49.88	7.5
Residential		14.79	13.25	11.6
Commercial		9.71	8.63	12.5
Industrial		26.15	25.25	3.6
Other		2.97	2.76	7.6
Fuel Consumption	Oct.			
Coal—million tons		13.59	13.32	2.0
Oil—million barrels		6.81	6.95	−2.0
Gas—billion cu ft		145.06	123.58	17.4
Net Income Class A & B Co's—$ million	Oct.	124.92	113.68	9.9
Residential Customers—millions	12 mos.	48.74	47.56	2.5
Revenue per kwhr	ended	2.51¢	2.53¢	−0.8
Avg kwhr per customer	Oct. 31	3,540	3,347	5.8
Avg annual bill		$88.85	$84.68	4.9

Business Statistics

Indexes: 1947–49 = 100				
FRB Industrial Production	Nov.	150	144	4.2
ENR Construction Cost	Jan.	170.2	163.2	4.3
BLS Cost-of-living	Nov.	125.6	123.9	1.4
New Orders for Machinery (1950 = 100)	Nov.	159	141	12.8
NEMA Sales				
Insulation materials	Oct.	164	135	21.5
Electric appliances		108	109	−0.9
Wholesale prices				
Motors and generators	Oct.	144.7	146.9	−1.5
Transformers and regulators		149.7	148.8	0.6
Switchgear and fuses		178.6	172.1	3.8
GNP—annual rate—$ billion	3rd qtr	478.6	444.0	7.8

Significant changes: NEMA's index of appliance sales fell below year-ago levels in October for the first time since July 1958. But last October had been the best autumn month for sales since 1945.



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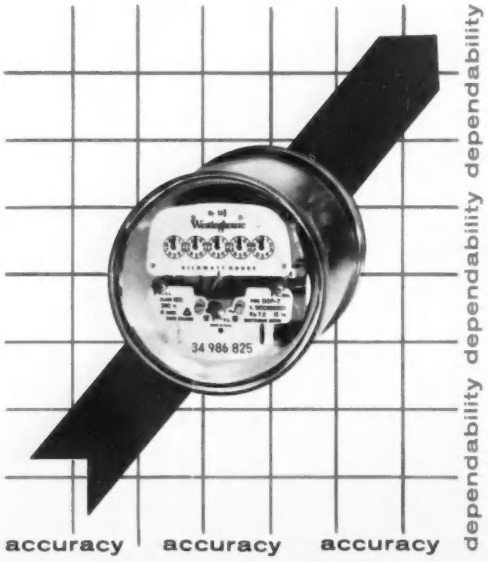

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Details Out on Columbia Development

International Joint Commission's principles submitted to U. S. and Canadian governments. Early Canadian action foreseen while doubt about Libby Dam may slow U. S. proceedings before treaty is signed

General principles for coordinated development of the upper Columbia River were released in detail by the International Joint Commission on Dec. 30.

These principles, signed by all five members of the commission, have been submitted to the U. S. and Canadian governments for final approval. Canada—eager to start development on the river—is likely to sign the agreement first. The U. S., on the other hand, may hold off its approval until political powers in the Pacific Northwest have determined that the IJC principles won't slam the door on the proposed Libby Dam project on the Kootenai River in Montana.

The principles, drafted by IJC in less than a year, calls basically for formulas of U. S. payments—in dollars and power—for benefits to river operations in the U. S. created by upstream Canadian dams. In simplified language, half of any added U. S. production, created by Canadian hydro projects, would be transmitted to Canada as kilowatts. And half of any U. S. flood-control benefits from Canadian dams would be paid to Canada in dollars.

Feasibility Must Be Included

IJC points out that the determination of, and payment for, power and flood-control benefits must also be subject to other considerations for each country, including feasibility. And the commission adds that the bases for determinations are subject to rapid change as the Columbia River basin is developed—reviews should be made every five years, in addition to special reviews.

Here's a run-down of IJC's recommendations, on which the feasibility of specific projects would be based:

• Hydro projects should be considered for development in order of their feasibility. Most favorable benefit-to-cost ratios should be built first. However, economy must also be subject to "many vital and important national interests" in each country.

• Cooperative development of the Columbia should produce cost-savings advantages in power, flood-control and other factors, in comparison with other available alternatives.

• Benefits or "entitlements" of each country for each project should be determined individually by mutual agreement, and these entitlements would be the basis for figuring river benefit payments by the downstream nation for upstream reservoirs.

U. S. Hydro Plants Would Benefit

• Downstream hydro generating plants in the U. S. would benefit "materially" at the present from both added power output and from added firm capacity. As more hydro plants are developed on the Columbia, however, thermal plants will be built in the U. S. to back them up and the benefit to downstream power plants will shift entirely from firm capacity to added peaking capacity—requiring a reassessment of power benefit values. This trend will be much slower in Canada.

• These recommendations for joint power development will require interconnection and coordination of the major power systems in both countries in the Columbia Basin.

Advance Planning Suggested

• All benefits to downstream power operations should be determined on the basis of an "assured plan of operation" of upstream storage. These benefits to power operations, attributable to upstream storage projects, should be estimated as far in advance as possible, but should be subject to review at least every five years. This advance planning will aid coordinated storage and power operations, as well as planning for necessary transmission.

• Since the value of upstream storage projects varies in the degree to which the river is developed, a firm date should be set on which future projects can be evaluated. The IJC recommends Jan. 29, 1959, the date that Canada and the U.S. asked IJC to draft these principles.

• Since added dependable power generating capacity by downstream plants can best be determined at present only by relationship to their increased dependable power loads, a new method should be found, which is less dependent on considering these load patterns. This is because load patterns—and values—may differ considerably at the time in the U.S. and Canada. The dollar value on downstream power benefits should be based on an estimate of the most economic alternate source of obtaining that same amount of power.

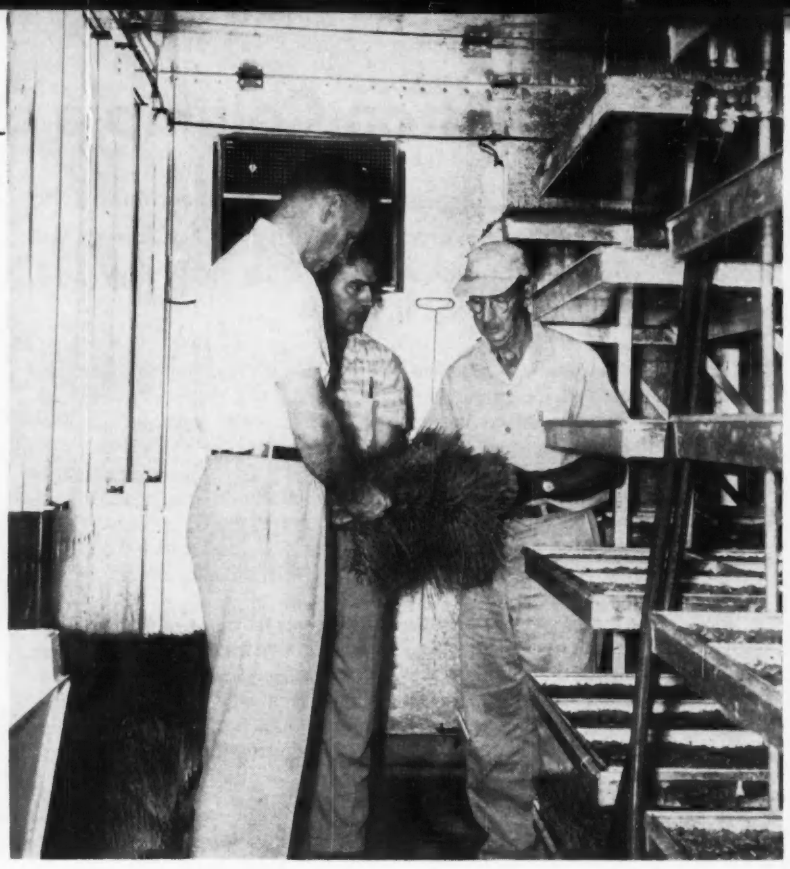
• Power benefits created for downstream power plants should be divided between Canada and the U.S. as close to 50-50 as possible, "provided that such sharing would result in an advantage to each country." Both nations should build necessary power facilities within their own borders.

Cash Planned for Flood Control

• Flood control benefits to the downstream country should be figured on an assured plan of operations. These payments, in cash, should be based on half the value of damages assumed to be prevented. And the evaluation should be based on the average annual value of flood damage prevented.

• All added storage—to prevent flooding—would be given equal credit, in the U.S. or Canada to reach a control level of 800,000 cfs at the Dalles on the Columbia, or of 60,000 cfs at Bonners Ferry on the Kootenai. Flood control storage above those levels would be evaluated "at a lesser rate."

• If the downstream nation requires special flood-control action by the upstream nation, then compensation must be made for reduced power operations by the upstream nation.



FRESHLY HARVESTED OATS are examined by (l to r) Clayton Rogers, Alabama Power district manager, J. L. Kendrick, rural service manager, and T. L. Crowder Sr. Note heat pump mounted in back wall and fluorescent lighting strips to left

Heat Pumps Help Grow Oats Year 'Round

SAMUEL H. BOOKER, Chief Agricultural Engineer, Alabama Power Co, Birmingham, Ala.

Cows on an Alabama farm are now getting spring oats the whole year around. The farmer is getting a higher level of milk production. And electric heating is the sparkplug.

When T. L. Crowder Sr, a dairyman of Elmore County, Ala., became interested in hydroponics (the growing of vegetables or plants using chemicals instead of soil, and using water instead of soil as the catalytical agent) he found that a 68F temperature maintained the year 'round was required for maximum production of green oats. To produce this environment he sought the assistance of Alabama Power Co rural engineers. Together they built the first green food producing incubator in the state. Now there are two others, with several more being planned. Each installation uses approximately 2,000 kwhr during every month of the year.

Crowder's incubator, a 12x200-ft prefabricated unit, is completely insulated and equipped with two 1-hp, window-type heat pumps. The heat pumps are used to provide growing trays with nutrient salt solution. Each unit uses approximately 400 gal of water per week.

The interior of the incubator is lighted 24 hr a day with 1,080 w of fluorescent lighting. Connected load is 4.38 kw with an ideal load factor.

This indoor farm will produce some 90 tons of green food per year, with a new crop every eight days. Seed is first put in plastic pails and these are immersed for 24 hours in a vat containing a germination speeding solution. Pails are then removed from the vat and stand for another 24 hours on a rack. After these preliminary steps, the sprouting seed is placed in trays to grow until ready for harvest.

The seed contributes about two-thirds to the total production cost of approximately $12.50 per ton of green food. Every morning 20 of the 360 trays are planted and 20 are havested. One lb of seed will produce six to seven lb of green feed about 8 in. in height. The plant and harvesting operation requires about 45 min a day.

Crowder's 40 dairy cows are fed spring-like grass each day. Every cow receives a 10-12 lb helping of spring oats in addition to the regular feeding. During the hot summer months when the pastures are failing, the incubator produced oats increase milk production 100 lb per day. This winter an increase to at least 200 lb per day is expected.

The incubator will pay for itself in three years if all profits from increased milk production are applied to it, Crowder says. The estimated life of the unit is 20-25 years.

Detroit Ed Salesman Makes Unusual Trade

Detroit Edison is selling electric water heaters even if its salesmen have to make some peculiar deals to close sales.

Salesman Herb Beisiegel agreed to buy 35 pigs from a farm customer in order to sell a new electric water heater.

The deal turned out to be profitable for both sides. The farmer now gets hot water fast; Beisiegel fattened the pigs all winter on his farm and sent them to market at a nice profit.

Rural Man Says Farm Automation Approaching

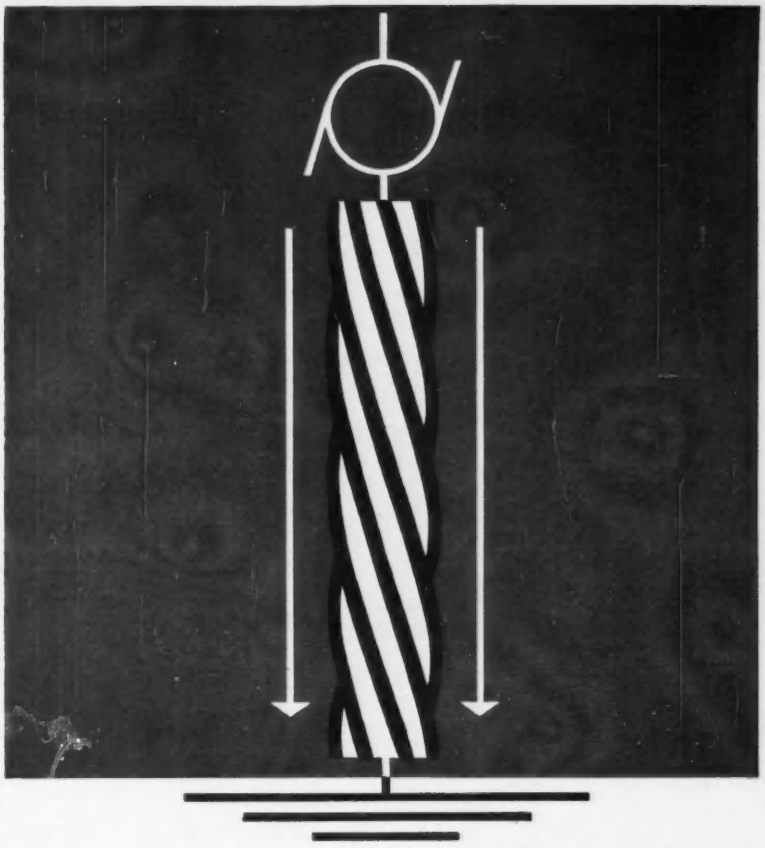
Electric power and feed handling are coming together because "there is no better or cheaper way to handle feed than with electricity," and because of the scarcity and unreliability of present-day farm labor. Roy J. McCraney, division rural sales engineer, Georgia Power, noted recently. Because the number of agricultural workers in the country is dropping rapidly the only way for agriculture to go is toward "consolidation, mechanization, or automation . . ." he said.

Carrier Offers Expanded Electric Heating Line

An expanded line of electric heating equipment will be presented by the Unitary Equipment Division of Carrier Corp. Two complete lines of electric resistance heating equipment will be added to the company's product line. They include wall-insert heaters and baseboard panels.

For new home construction, Carrier will offer a complete line of continuous baseboard low-rise units in five sizes. The company will also introduce a line of self-contained baseboard heaters for supplemental heating, in sizes from 2½ to 8 ft in length, and from 300 to 1,250 w. Wall-insert heaters will be offered in 1,500 to 4,000-w sizes.

A special bathroom unit, featuring an on-off switch and built-in thermostat will also be marketed.



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Twohey Heads Narragansett Electric

Edward G. Twohey has been elected president of Narragansett Electric Co, succeeding William Webster, now president of the New England Electric System.

Twohey, an electrical engineer, joined NEES in 1925 as a student engineer with the Lowell Electric Light Co. In 1929 he became assistant to the manager of Worcester County Electric Co, and then, the next year, was named merchandise manager of Lawrence Gas & Electric Co. He was made vice president of Northampton Electric Co in 1942 and later held the same office with the Worcester utility. He was vice president and general manager of Narragansett Electric Co for the last two years as well as being named president of Attleboro Electric Co in April, 1958.

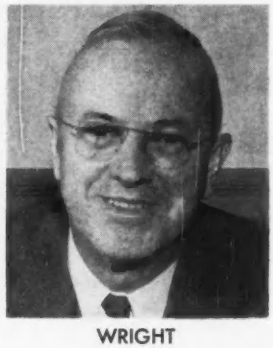
NEGEA Names Chandler, Wright Vice Presidents

CHANDLER

Horton L. Chandler has been named vice president of the New England Gas & Electric Assn Service Corp. and Roy E. Wright has been named vice president for sales of New England Gas & Electric Assn. Chandler will specialize in public relations.

A native of New Hampshire and a graduate of Dartmouth College and Harvard Law School, Chandler joined NEGEA in 1946.

Wright joined the New England Gas & Electric System in 1930 as supervisor of house heating and commercial sales and in 1957 was made director of gas and electric sales for NEGEA.



WRIGHT

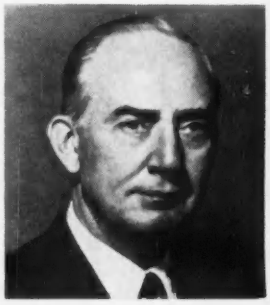
Kenney Made President of Foster Wheeler Corp

Foster Wheeler Corp has made John E. Kenney president and chief executive officer. He succeeds W. L. Martwick who was elected chairman of the board. Admiral Earl W. Mills, USN (ret), former chairman, has retired.

Clark P. Lattin Jr, vice president in charge of sales, has been elected a director.

Kenney has spent most of his 22 years with the company in Chicago in charge of midwest operations, and has been executive vice president of the corporation since 1958.

Martwick was in the sales division for 33 years before being elected president in 1958.



KENNEY

MARTWICK

English Electric's Nelson Named a Baron

Sir George H. Nelson, chairman of English Electric Co Ltd, has been named a baron in Queen Elizabeth's New Year's Honor List in recognition of his services to British industry and industrial development.

Sir George was appointed managing director of English Electric in 1930 and became chairman in 1933.

A knighthood was conferred on him in 1943 in recognition of his public service. He was created a baronet in 1955. His new title has not yet been announced.

PERSONAL BRIEFS

James F. Fairman, senior vice president of Consolidated Edison Co of New York, Inc, has been awarded the 1959 Edison Medal by the American Institute of Electrical Engineers.

British Columbia Electric Co has appointed **G. Arnold Johnson** general manager of the new General Services Division. He will be in charge of office services, stores, purchasing, building operations and maintenance, security and service vehicles.

Arthur Wachter has been elected president of the Electrical Assn of New Orleans, Inc.

Paul B. McKee, chairman of the board, Pacific Power & Light Co, has been chosen as Portland, Ore-

(*Continued on page* 92)

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gon's First Citizen of 1959. National Assn of Manufacturers has made **Donald R. McClung,** president, PP&L, a director.

Carl B. Vance, superintendent of power production at Indianapolis Power & Light Co has been appointed to the Board of Registration of Professional Engineers and Surveyors. He will serve until June, 1962.

Thomas E. Delzell, chairman of the board and chief executive officer of Portland General Electric Co, has been elected president of the Portland Chamber of Commerce.

Tennessee Valley Electric Institute's Western Division has as its new president, **Weldon Y. Howell,** manager of the Trenton Light & Water Dept.

Joe E. Stone Jr has been named manager of Duke Power Co's Reidsville district. He succeeds **A. N. Turner** who retired December 31 after 42 years of service.

American Electric Power Service Corp has named **Richard N. Fitch** head of the system operating section. **James T. Taylor** has been made head of the general auditing department.

John K. Davis, president, Toledo Edison Co, has been elected to the board of directors of the Ohio Valley Electric Corp.

OBITUARY

Mrs. Amy Allen Thompson, 54, home service director for the Florida Power Corp . . . **Owen M. Ward,** 74, former superintendent of electrical operations for Milwaukee Electric Co . . . **Willis L. Rand,** 63, southeastern district engineer for General Electric Co . . . **William T. Mohr,** 55, sales promotion manager for the Defiance Division of Toledo Edison Co . . . **Robert F. Haeberle,** 66, structural engineer for the Philadelphia Electric Co . . . **William S. Moscrip,** 82, member of Northern States Power Co's Board of Directors.

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The Meetings Calendar

JANUARY—1960

Edison Electric Institute—EEI-AGA Taxation Accounting Committees, Sheraton-Jefferson Hotel, St. Louis, Mo., Jan. 25-27.

Hydraulic Institute—Homestead, Hot Springs, Jan. 25-27.

Canadian Electrical Association—Eastern Zone, Chateau Frontenac, Quebec, Canada, Jan. 25-28.

• **Pennsylvania Electric Association**—Land and Land Rights Committee, Philadelphia, Pa., Jan. 28-29; Personnel Practices Committee, Reading, Pa., Jan. 28; Accident Prevention Committee, Pittsburgh, Pa., Jan. 28-29; Transmission & Distribution Committee, Pittsburgh-Hilton Hotel, Pittsburgh, Pa., Jan. 28-29; Structures & Hydraulics Committee, Penn-Sheraton Hotel, Pittsburgh, Pa., Jan. 28-29.

National Association of Purchasing Agents — Public Utility Buyers Group, Mid-Winter Meeting, Atlanta Biltmore Hotel, Atlanta, Ga., Jan. 31-Feb. 1-2.

American Institute of Electrical Engineers—Winter Meeting, Hotel Statler, New York City, Jan. 31-Feb. 5.

FEBRUARY

Edison Electric Institute—Prime Movers Committee, Sheraton-Cleveland Hotel, Cleveland, Ohio, Feb. 1-3; Industrial Power & Heating Group, Netherland Hilton Hotel, Cincinnati, Ohio, Feb. 4-5; Electrical System & Equipment Committee, Bellevue-Stratford Hotel, Philadelphia, Pa., Feb. 15-16; EEI-AGA Accounting Conference Final Working Meeting, Sheraton-Cadillac Hotel, Detroit, Mich., Feb. 15-16; Commercial Cooking & Water Heating Committee, Atlanta, Ga., Feb. 18-19.

Instrument Society of America—Instrument-Automation Conference and Exhibit, Sam Houston Coliseum, Houston, Tex., Feb. 1-4.

American Society of Heating, Refrigerating and Air-Conditioning Engineers—Semi-Annual Meeting and Second Southwest Heating and Air-Conditioning Exposition, Baker Hotel, Dallas, Texas, Feb. 1-4.

Fourth National Industrial Electric Heating Conference—Sponsored by The Industrial Electrification Council, Netherland-Hilton Hotel, Cincinnati, Ohio, Feb. 1-4.

American Society for Testing Materials — Committee Week, Hotel Sherman, Chicago, Ill., Feb. 1-5.

• **Pennsylvania Electric Association** — Electrical Equipment Committee, Harrisburg, Pa., Feb. 4-5; Stores Committee, Harrisburg, Pa., Feb. 5; Joint Meeting of Relay & Communications Committee, Hotel Bellevue-Stratford, Philadelphia, Pa., Feb. 11-12; System Planning Committee, Hotel Pittsburgh-Hilton, Pittsburgh, Pa., Feb. 15-16; Residential Committee, Philadelphia, Pa., Feb. 15-16; Motor Transportation, Johnstown, Pa., Feb. 18-19; General & Customer Accounting, Pittsburgh Airport, Pittsburgh, Pa., Feb. 18-19; Prime Movers Committee, Hotel Bellevue-Stratford, Philadelphia, Pa., Feb. 18-19; Commercial Committee, Pittsburgh, Pa., Feb. 24-25; Taxation Committee, Pittsburgh, Pa., Feb. 25-26.

National Electrical Week—Feb. 7-13.

Missouri Valley Electric Association—Industrial & Commercial Sales Conference, President Hotel, Kansas City, Feb. 8-9.

American Institute of Mining, Metallurgical and Petroleum Engineers—Annual Meeting, Hotel Statler, N. Y., Feb. 14-18.

Agricultural Cooperative Conference—University of Kentucky, Feb. 16-17.

• **American Public Power Association**—Engineering & Operations Workshop, Town House, Kansas City, Kan., Feb. 17-19.

• **American Marketing Association** — Sixth Annual Public Utilities Seminar, Chase Hotel, St. Louis, Mo., Feb. 18-19.

• **National Society of Professional Engineers**—Winter Meeting, Broadview Hotel, Wichita, Kan., Feb. 18-20.

• **National Rural Electric Cooperative Association**—Annual Meeting, St. Louis, Mo., Feb. 22-25.

• **California Municipal Utilities Association**—Annual Conference, Miramar Hotel, Santa Monica, Calif., Feb. 23-26.

• **Sixteenth Annual National Wiring Sales Conference**—Warwick Hotel, Philadelphia, Pa., Feb. 25-26.

• **Pacific Coast Electrical Association**—Business Development Meeting, Hotel Lafayette, Long Beach, Calif., Feb. 29-March 1.

MARCH

• **Southern Safety Conference** — Robert Meyer & George Washington Hotels, Jacksonville, Fla., March 6-8.

• **American Society of Mechanical Engineers**—Gas Turbine Power Division & Hydraulic Division, Rice Hotel, Houston, Tex., March 6-9.

• Additions this week.

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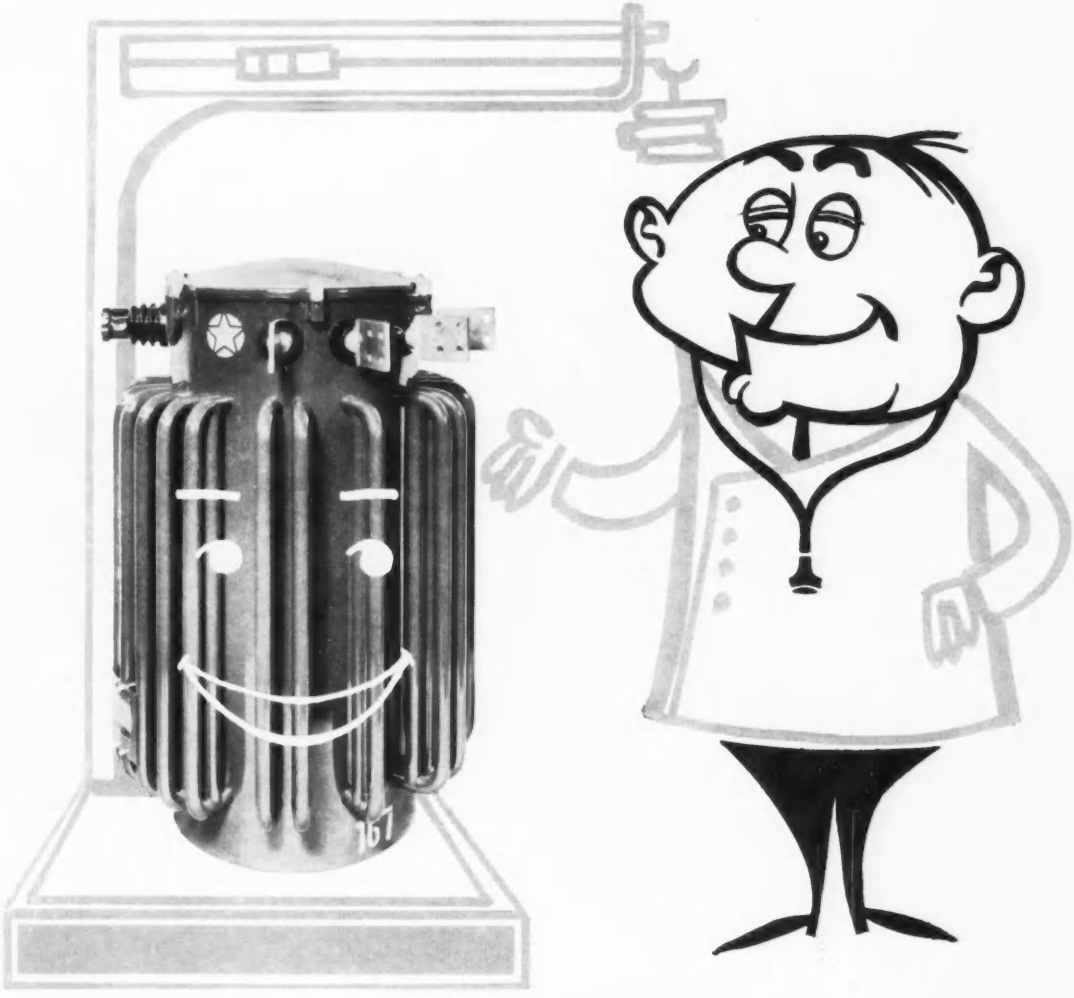
167-kva Featherweight Pole Star® now weighs in at 1350 lbs.



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The Kuhlman Gold Transformer program ties right into the industry's great drive for electric home heating. It will establish a bright, attractive, easily-recognized symbol that will get the public's attention and approval.

It's backed by a *selling* campaign, with advertising, sales promotion and sales helps to back up the Gold Transformer as a symbol for electric heat.

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